

Constructive Alignment in Primary Science Teaching Practice Towards Inquiry and its Effect on Developing Curriculum Document

A thesis submitted in fulfillment of the requirements for the degree of
Doctor of Philosophy



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Dedicated

To

My parents

My husband Dr. Muhammad Nur-E-Alam Siddiquee

&

Kids Hrydita Nur Siddiquee

Rodoshi Nur Siddiquee

Declaration

This is **Rezina Ahmed**, hereby declare that the entitled “Constructive Alignment in primary science teaching practice towards inquiry and its effect on developing curriculum document” is my own effort and that to the best of my knowledge and belief under the supervision of **Dr. S M Hafizur Rahman**, Professor, Department of Science and Technology Education, Institute of Education and Research, University of Dhaka. This thesis contains no material which has been accepted for the award of any other degree or diploma at any university or other institution or previously published.

Signature:

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List of Acronyms

A	Assessment
AAAS	Association for the Advancement of Science
AG	Assessment Guide
AUEO	Assistant Upazila Education Officer
BBS	Bangladesh Bureau of Statistics
CA	Constructive Alignment
C-in-Ed	Certificate in Education
DPE	Directorate of Primary Education
DPEd	Diploma in Primary Education
DPEO	District Primary Education Officer
ILO	Intended Learning Outcome
LA	Learning Activities
MoE	Ministry of Education
MoPME	Ministry of Primary and Mass Education
NCTB	National Curriculum and Textbook Book Board
NRC	National Research Council
PTI	Primary Teachers Training Institute
TB	Textbook
TE	Teacher's Edition
URC	Upazila Resource Centre

Abstract

It is very essential to maintain the alignment among the intended learning outcomes (ILOs), learning activities (LAs), and assessment (As) for effective teaching-learning. However, it is a common question among the stakeholders about the existing alignment in primary science teaching practice toward inquiry in Bangladesh. The study explored the constructive alignment of ILOs, LAs, and As in primary science teaching practice toward inquiry. The study also explored the effects of existing constructive alignment in developing the curriculum document.

Within the qualitative framework, a case study approach was applied purposively, focusing on the primary science teachers of rural and urban (who teach science). Each case was considered with three concerned stakeholders (Assistant Upazila Education officer, instructors of Upazila Resource Center, and Primary Teachers Training Institute) and the concerned primary students. Primary science textbooks, teacher's editions, and assessment guide; primary science examination questions were also the sample. Data collected from lesson observation, semi-structured interviews, in-depth interviews, document analysis, and focus group discussion were analyzed by qualitative content analysis and thematic analysis.

The findings indicated that in the primary science teaching practice of Bangladesh, constructive alignment does not exist in ILOs, LAs and As. Specifically, findings showed that teachers and concerned stakeholders have somewhat comprehension of ILOs, LAs, and As, with some challenges which were reflected in classroom practice. Mostly, curriculum documents somewhat addressed the information of ILOs, LAs, and As. The findings found that the existing status of concerned stakeholders' comprehension of the components of constructive alignment matches the existing status of the curriculum documents. Finally, the study revealed that concerned stakeholders' comprehension may effect the development of curriculum documents.

The findings of the existing alignment in primary science teaching practice and its effect on developing curriculum documents, carry implications for the Ministry of Primary and Mass Education, curriculum developers, policymakers, National Curriculum and Textbook Boards to evaluate the different aspects of the education system and take into account for improvement accordingly to have skilled citizen further. The findings provide knowledge to the literature which will help curriculum developers, textbooks, and teacher's edition writers to develop curriculum documents and researchers for further research on educational settings.

Chapter One: Introduction of the Study

1.1 Introduction

Inquiry is echoing everywhere in science education. National Science Education Standards (National Research Council [NRC], 1996) states “Inquiry is central to science learning”; and also advocate the use of inquiry in science teaching. However, the NRC (2000, 2003, 2011) considered inquiry as one of the most important teaching-learning approaches around the world. Inquiry is a fundamental system where humans can most effectively go to acquiring knowledge (Short, 2009). Inquiry-based education has the capacity to enhance students’ interest and performance in science. Moreover, inquiry enables students to acquire the skills and knowledge that will be needed in their daily lives and to improve those skills and knowledge over time (Duban, 2014; Saka & İnaltekin, 2021; Şaşmaz-Ören & Sari, 2019; Schroeder et al., 2007). Inquiry-based learning engaged students in the activities of research and analysis throughout the learning experience that have also been suggested to as higher-order thinking and questioning (Crawford, 2014; Levy et al., 2009; Marzano, 2003; NRC, 2012; Osborne & Dillon, 2008). Students can internalize knowledge and skill that are acquired through inquiry-based learning under the guidance of a teacher (Tezel, 2018). In this sense, scientific inquiry is viewed as a teaching approach used to communicate scientific knowledge and allow students to construct their own knowledge (Lederman & Lederman, 2012). Teaching as inquiry involves investigating, problem-solving, and research aimed at improving the teaching practice (Aulls et al., 2008; Conner, 2015).

In education system, alignment can be broadly defined as the degree to which the components of an education system such as standards, curricula, assessments, and instruction work together to achieve the desired goals (Ananda, 2003; Case et al., 2006; Resnick et al., 2003). The conceptions of alignment have become increasingly practiced in education to meet goals for strengthening education systems. Learning outcomes, teaching-learning activities, and assessment are inextricably related, and their alignment or high consistency has been crucial for achieving the goals of education which help to make the overall learning experiences more transparent (Biggs, 1999, 2003, 2011, 2014; ECTS

Users' Guide, 2005). However, Biggs (2003, 2014) also argued that effective teaching-learning requires a careful alignment of intended learning outcomes, learning activities, and assessment. moreover, It is important to ensure that the curriculum, assessment, and instruction in the science program are aligned, as the research literature indicates that constructive alignment enhances learning outcomes (Biggs & Tang, 2011). As well as, teachers are the most important link that connects assessment, instruction, and teaching learning (Keeley, 2016).

1.2 Context of the Study

1.2.1 Bangladesh: A brief introduction

The People's Republic of Bangladesh is located in the north-eastern part of South Asia. The grand Himalayas stand some distance to the north, and in the south places the Bay of Bengal. West Bengal borders on the west and in the east lies the hilly and forested regions of Tripura, Mizoram (India), and Myanmar. Bangladesh is situated on the Ganges Delta (the largest delta in the world and also the largest wetland in the world) with a geographical location of Latitude

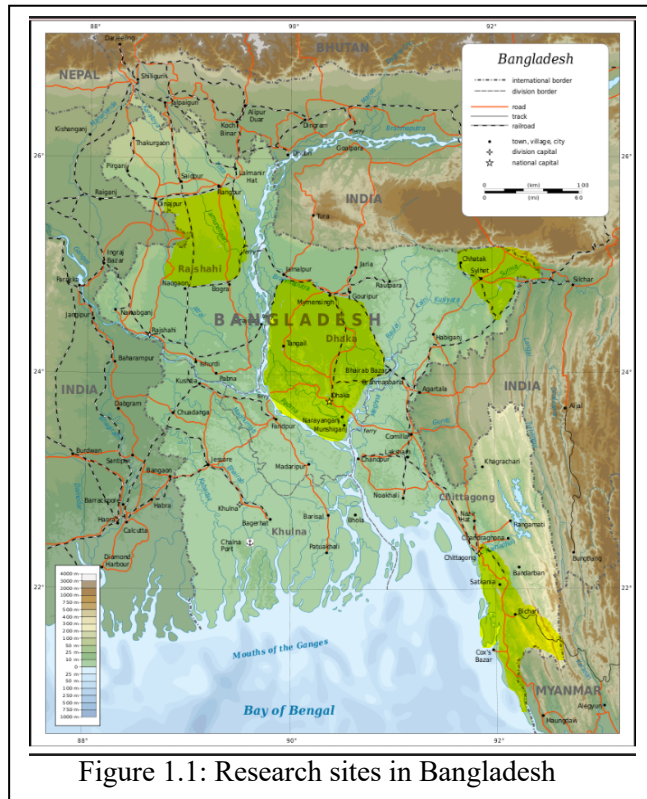


Figure 1.1: Research sites in Bangladesh

between 20°34' and 26°38' North, Longitude between 88°01' and 92°41' East. These picturesque geographical boundaries frame a low-lying plain of about 1,47,570 square kilometers (land: 1,33,910 sq km, water: 10,090 sq km), criss-crossed by immeasurable rivers and streams. Mighty rivers are Padma (Ganges), Brahmaputra (Jamuna), Meghna, and Karnafuli. In terms of population, Bangladesh is the eighth-largest country, and fourth-most densely populated country with a population of 165,158,616 people in the world; as

many as 113,063,587 of them live in rural areas and 52,009,072 live in urban; the literacy rate in Bangladesh is now 74.66% (Bangladesh Bureau of Statistics [BBS], 2022). Mother Language is Bangla (the national language) spoken by 95%. English is widely understood and spoken.

1.2.2 Education of Bangladesh: An overview

Structure

The education system in Bangladesh is divided into main three major stages: primary, secondary, and higher education. Primary education is a five-year cycle; secondary education comprises seven years of formal schooling with three sub-levels: three years of junior secondary; two years of secondary; and two years of higher secondary. Higher secondary is followed by graduate-level education in general, technical, engineering, agriculture, business studies, and medical streams requiring four-six years to obtain a Bachelor and/or Master's degree (Ministry of Education [MoE], 2020). The Master's degree is of one-year duration for holders of Bachelor Degree (Honors) and two years duration for holders of a Bachelor Degree (Pass).

Primary Education in Bangladesh

The first stage of formal education is known as Primary education. In Bangladesh, formal primary education refers to education, as determined by the government for the children of age group 6+yrs to 10+yrs years in grades 1-5 (Table 1.1) having a prescribed national curriculum, textbooks, schools' hours and the schools year, which begins in January and ends in December. It is preceded by two years of preschool or nursery education and is followed by secondary education. It is also called elementary education in other countries and is followed by middle school such as in North America. In Bangladesh, it is compulsory for children to receive primary education and free to all which was introduced in 1993 (Ministry of Primary and Mass Education [MoPME], 1990). Primary education is a basic demand of all children; and the basic education of the people of Bangladesh was given as a fundamental right in article no. 17 of the Bangladesh constitution. The major goals of primary education are achieving basic literacy and numeracy amongst all pupils as well as establishing foundations in science, mathematics, geography, history, and other social sciences (National Curriculum and Textbook Board [NCTB], 2012).

Table 1.1: Primary level (class and age) education in Bangladesh.

Class	Age
Class One	6+
Class Two	7
Class Three	8
Class Four	9
Class Five	10

The MoPME is the main provider of primary education in Bangladesh. More than 55.1% of schools are controlled by MoPME and around 70.2% of total children enrolled in primary-level educational institutions are in these schools. In 2021, the enrollment was 16,964,967 (Directorate of Primary Education [DPE], 2022). Similarly, about 74% of primary teachers are working in MoPME schools. Total govt. school is 63,041 and total teachers are 3,19,112. Two primary science classroom scene of this study is shown in Figure 1.2 and 1.3 from two different sites in Bangladesh.



Figure 1.2: Primary science classroom of grade four in an urban area



Figure 1.3: Primary science classroom of grade three in a rural area

Primary Science Curriculum

The national education policy of Bangladesh has developed in 2010. The primary science curriculum has been revised in 2011 based on the national education policy. There are 13 objectives and 29 terminal competencies in the primary curriculum, and 18 competencies are related to primary science (NCTB, 2012). One of the terminal competencies is “to

acquire the principles and methods of science, use these in problem-solving; to develop children to be science-minded and curious; produce human resources skilled in technology” (NCTB, 2012). Terminal competency is a combination of knowledge, skills, and attitudes; and it is expected that the competency of knowledge, skills, and attitude of the students would be reflected in their practical life through reading, writing, thinking, and analyzing (NCTB, 2012). Learning outcomes were developed, based on terminal competencies for each subject of each class at the primary level. It is stated as a major feature of the revised primary science textbooks that the basic layout of textbooks follows the sequences of problem-solving guided by inquiry.

1.2.3 Support for primary teachers’ teaching practice

Human support

Upazila Education Office (UEO), Primary Teacher Training Institute (PTI) and Upazila Resources Centre (URC) are the three responsible educational organizations for teacher supervision and professional development. Among these, the assistant Upazila education officer (AUEO) from UEO is the frontline supervisor for primary teachers at the field level who help teachers by giving professional support and advice to do their job properly (Education Watch, 2003/4). Besides this, PTI and URC are responsible for teachers’ professional development. Both organizations work on teacher development and supervision collaboratively to improve the teachers’ performance at the school level. The PTI is totally academicians; they always deal with fundamental theories of education and different approaches to education. The URC deals with practicalities of educational short-term issues; that arise in the time of practice.

In developing countries, teachers are not offered to choose teaching resources for implementing the intended curriculum, and they have to teach from one textbook which is fixed by educational policymakers (Quader, 2001; Wall & Alderson, 1993). Therefore, as a developing country, primary teachers of Bangladesh have to follow textbooks to get support for teaching practice. Besides this, the teacher’s edition/guide for primary education has been developed as a supporting instructional guide of the textbooks, that teachers usually use to prepare a lesson plan for the successful implementation of

curriculum instruction. A teacher's guide is "the main if not the only way curriculum writers can establish a direct link to teachers and clarify their intentions to them" (Shkedi, 1995, p. 155). It presents the material and activities to be conveyed to the students and can function as a teacher training manual by giving detailed advice on how to use a particular approach from textbooks.

Material support

i. Textbooks (TB)

To meet the 21st century's challenges and make students enable to compete in the world primary science textbooks were developed with a new approach based on the revised primary science curriculum with some major features (NCTB, 2012). Three main major features of the revised primary science textbooks are, user-friendly, emphasis on problem-solving based learning, enhancement of learning activities.

ii. Teacher's edition (TE)

To implement the aims and objectives of the primary curriculum, textbooks are developed with a new approach. The teacher's edition and teacher's guide has also been published with textbooks at the primary level in Bangladesh. The teacher's edition is an essential tool to instruct teachers in delivering the new curriculum to schools in Bangladesh. The main education system is divided into three levels in Bangladesh: 1. Primary Level (Class 1–5) 2. Secondary Level (Class 6-12) 3. Tertiary Level In the primary level for grades 1 and 2, The instruction guide for teachers is called Teacher's Guide. For grades 3-5 it is called Teacher's Edition. The Teacher's edition includes a key question first, and then the teaching-learning activities, expected science process skills, attitudes and values, and sample question to assess students' understanding is given sequentially.

iii. Assessment guide (AG)

Assessment guides provides the needed instruction for formative and summative assessment. AG includes the assessment areas, tools, assessment techniques, and way of giving feedback for formative assessments. In case of summative assessment, AG provides assessment areas, tools, techniques, rubrics etc.

1.3 Problem Statement with Justification

In the primary science teaching practice of Bangladesh, research findings on the three components of constructive alignment have been found in a discrete manner.

Intended learning outcomes (ILOs)

Intended learning outcome a clear statement of what a learner is expected to be able to do, know about, and/or value at the completion of a unit of study. Teachers are solely responsible for implementing the intended learning outcomes (ILOs) through their teaching practices. But in most cases, teachers conduct lessons without focusing on the intended learning outcome (Rahman, 2015).

Learning activities (LAs)

To maintain an effective teaching-learning, planning lesson is important and it will give structure to the discussion, activities, and assessment of the class. But research has shown that, in most cases, teachers do not follow the intended learning outcome of lessons in planning their classes (Rahman, 2015).

In science inquiry, prior knowledge is the first essential feature and teachers are responsible for creating an effective learning environment by connecting students' prior knowledge to construct new knowledge. Teachers can facilitate students activate prior knowledge before introducing new lessons and/or by answering questions. In most cases in Bangladesh, teachers are not aware of this (Rahman, 2015).

The teacher plays an important role in the implementation of inquiry-based learning. But teachers were not ready to implement inquiry in the classrooms since they did not possess the skills needed for effective implementation of inquiry activities. Sultana, Rahman and Islam (2019) found although teachers were concerned about scientific inquiry, they hardly use this approach for teaching-learning.

Students have their own words to explain the content or event and need time to think, express or explain and share with others after observation or understanding. Teachers have to keep aware of that matter but research found, in most cases, teachers do not want to give them enough time to think and explain (Rahman, 2015).

Teaching method or strategies is one of the most important parts of effective teaching. Sometimes teachers have to select multiple strategies based on content but in most cases, they did not do so (Rahman, 2015). Therefore, the teaching-learning is incomplete and students are unable to understand properly (Education watch, 2015).

Different levels (of intelligence) of students are in the classroom high, medium, and low, or attentive and unconscious. Therefore, teachers need to pay attention to all types of students and engage them in meaningful learning. But in most cases, teachers did not give their attention to all the students in the classroom (Rahman, 2015).

Assessments (As)

Most teachers are being unaware of whether the intended learning outcome is achieved or not after the completion of a lesson (Rahman, 2015). Previous research found a great deal of mismatch between the suggested percentage of assessment areas by NCTB and the focused percentage areas of intended learning outcomes in the curriculum (Ahmed, 2015). Teachers also have given less emphasis on assessing the most valued learning outcomes and doing ongoing assessments (Khan et al., 2016).

1.4 Research Gap in the Existing Literature

The national goal of primary science education has been set to create scientifically minded citizens as well as “scientific literate” citizens as the future generation who are expected to solve many social problems in Bangladesh (NCTB, 2012). Moreover, previous research revealed that the intention of the primary science curriculum does not promote scientific literacy (Siddique, 2014), and the primary science teaching practice does not promote scientifically literate citizens (Rahman, 2015; Khan et al., 2016). In education learning outcomes, teaching-learning activities, and assessment are inextricably related and their alignment or high consistency has been crucial for achieving the goals of education and this connection among the three helps to make the overall learning experiences more transparent (Biggs & Tang, 2011; ECTS Users’ Guide, 2005). Although a set of curriculum materials can be aligned with the ultimate goals of the curriculum, the achievement of these goals is largely dependent on its actual mode of implementation in the classroom. In

Bangladesh, some research has been conducted on primary science curriculum intention, practice, and assessment in a discrete way; but a study on the constructive alignment of curriculum intention, practice, and assessment in classroom teaching practice towards inquiry did not conduct yet. Therefore, this study may provide a complete empirical document on the alignment of curriculum intention, practice, and assessment in classroom teaching practice towards the inquiry.

1.5 Significance of the Study

The findings of this study may help researchers of science education and the education authorities to know and take necessary steps about the existing status of constructive alignment on primary science teaching practice and its effect on developing curriculum documents. The authorities and institutes, involved in teacher educators' professional development, may address the finding of the study to design and implement training programs emphasizing the existing alignment in primary science teaching practice. By considering the existing alignment of primary science teaching practice, policymakers take into account many aspects of primary science education in Bangladesh. Moreover, the findings from this study should enable educators, policymakers, and curriculum developers to evaluate the different aspects of the education system and to make changes for improvement accordingly.

1.6 Research Purpose and Research Questions of the Study

The purpose of this study is to explore the constructive alignment of intended learning outcomes, learning activities, and assessment in primary science teaching practice toward inquiry. The study also explores the effects of existing constructive alignment in developing the curriculum documents.

- Central Question

How does the situation of existing constructive alignment towards the inquiry approach effects the development of primary science curriculum documents?

- Sub-question

1. How do primary science teachers comprehend the focus of intended learning outcomes in line with inquiry-based teaching-learning?

2. How do primary science teachers comprehend the approaches of primary science textbooks and teacher's editions to facilitate inquiry-based teaching-learning?
3. How learning opportunities of inquiry-based teaching are practiced in the science classroom?
4. How do primary science teachers perceive the practiced assessment methods to achieve the intended learning outcomes?
5. How do primary science teachers perceive the extent of students learning towards achieving the intended learning outcomes?
6. What challenges do primary science teachers face to practice inquiry in the science classroom?
7. What is the effect of existing alignments on developing curriculum documents?

1.7 Outline of the Thesis

This thesis comprises of seven chapters. An overview of the seven chapters is given below-

Chapter One is an introductory chapter that provided an overview of the study. It includes the context of the study, problem statement with justification, research gap, audience of the study, research purpose and research questions of the study. This chapter also provides an outline of the structure of each chapter.

Chapter Two provides a comprehensive review of the literature and theoretical framework. In this chapter, the study broadly reviewed relevant literature on existing primary science curriculum, existing science textbooks and its approaches, inquiry approach, and alignment of curriculum.

Chapter Three includes an overview of the methodology chapter. It covered conceptual framework of the study, philosophical worldview, strategy of inquiry, research design, source of data, sample, sampling, instruments, data collection process, data analysis technique, trustworthiness, ethical issues, methodological challenges and limitations of the study have been discussed in this chapter.

Chapter Four presents the results of the qualitative data. Thematic analysis is followed for qualitative data analysis. Themes are analyzed according to the nine key approaches of

the existing primary science textbooks and inquiry approaches, which are mentioned in Chapter Two.

Chapter Five deals with the discussion of this study. The findings of the study have been discussed in relation to reviewed and relevant literature. This discussion has been organized according to the research questions.

Chapter Six presents several implications based on the findings and limitations of the study for future research are discussed.

Chapter Seven provides the conclusion of the study. It includes readdressing the research questions, answers of these questions and concluding remarks.

Chapter Two: Literature Review

This chapter comprehensively reviews all the concepts and issues relevant to this study. This chapter aims to provide a descriptive as well as a critical analysis of literature related to the research title ‘Constructive alignment of primary science teaching practice towards inquiry and its effect on developing curriculum documents’; which broadly includes primary science teaching practice towards inquiry, curriculum documents, and constructive alignment. Specifically, primary science teaching practices with primary science curriculum; primary science teacher; teachers supporting personnel, and documents are distinctly discussed. Inquiry, inquiry-based teaching, and challenges to implementing inquiry in the science classroom are also discretely discussed. Constructive alignment with its components of intended learning outcomes (ILOs), learning activities (LAs), assessments (A), and alignment of the curriculum are separately discussed.

2.1 Primary Science Teaching Practice in Bangladesh

Primary science teaching practice focuses on the primary science teachers; primary science curriculum; primary science teacher (who teaches science); teachers supporting documents: primary science textbooks, primary science teacher’s edition, assessment guide; and supporting personnel: AUEO, instructors of PTI and URC.

2.1.1 Primary science teachers

A primary teacher is a teacher who focuses on children aged 6+ to 11, and who facilitates a class of primary-grade students for an entire academic year; teaching a wide range of subjects chosen by the school. Usually, the primary teacher who teaches science in the class is considered the primary science teacher in this study. The minimum qualification of a primary school teacher is a bachelor’s or equivalent degree with a minimum second division or class from a recognized university. They get professional development programs like certificates in education (C-in-Ed) and Diplomas in Primary education (DPed). Besides these, they also get other short training like subject-based training for professional development.

The level of qualification of science teachers is one of the variables that contribute to student achievement in science (Ware, 1992a). The subject content knowledge of the science teachers, the ways of delivering instruction, and their attitudes toward science have an impact on students' achievement. Higher levels of student achievement tend to be associated with more qualified and experienced science teachers. Teachers' level of qualification also influences students' attitudes toward continuing study in science (Ware, 1992b).

2.1.2 Primary science curriculum

In Bangladesh curriculum was traditional content based which has been replaced with competency-based, which is called terminal competency (NCTB, 2012). There are 13 objectives and 29 terminal competencies in the primary curriculum, and 18 competencies are related to primary science. Terminal competency is a combination of knowledge, skills, and attitudes; and it is expected that the competency of knowledge, skills, and attitude of the students would be reflected in their practical life through reading, writing, thinking, and analyzing (NCTB, 2012). Then class-wise attainable competencies were developed. Learning outcomes were developed, based on terminal competencies as well as subject (content) for each class of primary level. Learning outcomes play an important role to create the link between Class wise attainable competencies and subject content. Assessment systems were also developed for achieving the aims and objectives of the curriculum (NCTB, 2012). The existing primary science curriculum has been practiced in Bangladesh Science 2013. One of the main objectives of the existing science curriculum is to grow learners' interest in science and thereby make them familiar with the mainstream of science practice (NCTB, 2012). The teaching of science at the primary level of education should aim at inspiring the learners and giving them pleasure in the journey of science learning, and the primary science curriculum is the complete preparation for creating such a favorable environment for science learning (NCTB, 2012).

A science curriculum is a teacher's intended plan including content, pedagogy, and assessment linked to achievement standards and school policies. The ultimate demand of a science curriculum is to make a scientifically literate citizen through an inquiry approach. The extent to which a science course develops scientific literacy is dependent on several

factors. First, the curriculum goals must explicitly state that scientific literacy forms a highly valued portion of the course; second, the curriculum itself must provide opportunities to learn the various aspects that comprise scientific literacy; third, teachers must support students to practice and apply these skills within appropriate learning activities; and fourth, assessments must provide opportunities to measure student achievement progress in developing scientific literacy.

2.1.3 Primary science textbooks

The textbook is used as a standard source of information for the formal education of a subject and an instrument for teaching and learning. According to Callison (2003), no other institutional technology has had more influence on teaching than the textbook. It is also considered a source of content, organization, and instructional activities for teachers to plan for lessons (Johansson, 2006; Woodward et al., 1988). The textbook is particularly important in situations where changes in teaching approach take place since it can introduce changes gradually within a structured framework enabling both teachers and learners to develop in harmony with the introduction of new ideas (Hutchinson & Torres, 1994). They also add that teachers claim “textbook saves time, gives direction to lessons, guides discussion, facilitates giving of homework, making teaching easier, better organized, more convenient” (p. 318). Research shows that teachers’ use of textbooks varies between developed and developing countries (George, 2001). George (2001) also indicates that, in developing countries textbooks are considered essential teaching material whereas teaching resources are available and teachers are generally trained to be independent of the text. In developing countries, teachers are not offered teaching resources to choose from for implementing the intended curriculum, they have to teach from one textbook that is fixed by educational policymakers (Quader, 2001; Wall & Alderson, 1993). According to Farooqui (2008), the textbook is considered a provider of input into classroom lessons in the form of activities and explanations. The textbook guides teachers in their instructional decisions and works as a compendium of curriculum resources and materials for teachers and students. Designed by commercial publishers for use exclusively in schools, these materials guide instruction and provide students with nonfiction texts gauged toward reading and interest levels.

➤ *Characteristics of science textbooks*

Kochhar (1985) suggested the characteristics of science textbooks-

- Well-illustrated with attractive colors, inspiring drawings, and photographs that are well-connected and sequential.
- The textbook should be up-to-date in content, frequently revised and reprinted when necessary.
- The textbook must be complete with its table of contents, illustrations, charts or other references.

➤ PISA also suggests the characteristics of primary science textbooks-

- Context: recognizing life situations involving science and technology.
- Competencies: Identify scientific issues, explain phenomena scientifically and use scientific evidence.
- Knowledge: Scientific knowledge, the natural world.
- Attitudes: Increase interest in science, scientific inquiry, and responsibility towards natural resources and environments.

➤ According to TIMSS, a primary science textbook should have the following characteristics-

- Content dimension: Nature and real-life-oriented content.
- Cognitive dimension: knowledge, application, and scientific inquiry.

➤ Anderson and Armbruster (1984) referred to the following characteristics of a science textbook-

- Structure: logical sequence, explanation, and procedure
- Content: Relevant ideas activities, procedures, or vocabulary probably beyond the common experiences of children at the intended grade level.
- Pictures and diagrams: Pictures and/or diagrams that are necessary to the text as well as those that are appropriately labeled.

➤ Thurber and Collette (1964) suggested six criteria for choosing a good science textbook. They are-

- Content
- Organization
- Literacy style vocabulary

- Illustrations
- Teaching aids
- Mechanical makeup and appearance
- Authorship

➤ ***Korean elementary science textbooks: Characteristics of a Lesson***

In Korea, there have been eight revisions to the National curriculum and the development of nine textbooks. The Korean primary science textbooks have been developed following the 'FLOW' development model based upon results of studies in creative education and developed the new science textbooks. The 'FLOW' model includes four stages, aimed towards capturing students' interest in science (Fun Science), engaging students in various scientific inquiries and experiences (Lab. Experience), organizing their knowledge of science (Organizing Knowledge), and encouraging students to become little scientists (Willing to be a Scientist). The textbook's basis is formed upon scientists' experiences that assist in the realization of 'inquiry' that is emphasized within the science field. The characteristics of a lesson in Korean science textbooks-

1. The subject matter attracts the students' interests and curiosity about science including real-life-oriented concepts and knowledge
2. Inquiry-based teaching-learning
3. Phenomena and activity-based class
4. Experiments based on scientific inquiry that aimed to develop scientifically skills.
5. Application of scientific knowledge
6. Promoting scientific literacy

➤ ***Japanese elementary science textbooks: Characteristics of a Lesson***

Japanese elementary school is one of the best in the world (Gardner, 2000). Since 1947, the Japanese curriculum has been revised every 10 years. These revisions aimed to involve students with a 'zest for living' rather than in terms of the quality of knowledge acquired. The characteristics of a lesson in Japanese science textbooks are as follows-

1. Learning through scientific inquiry
2. Activity-based class

3. Emphasizing the experiment and observation related to daily life
4. Emphasis on developing scientific views and thinking
5. students are expected to use their prior knowledge
6. Engaging students collaboratively
7. Starting a lesson with a key question
8. Extensive discussion.

➤ *Major refinements in Primary Science textbooks of Bangladesh*

Major Features of the Revised Primary Science Textbooks

(1) User-friendly

- Learning contents, illustrations and text presentations are considered taking into account the developmental stage of pupils, which emphasize mainly on the conceptual development rather than rote learning.
- Enquiring of pupils' prior knowledge and experience are tried to address in the lesson.
- Grade fitting simple texts and child friendly description.
- Clear titles, subtitles, and large number of illustrations and photographs.
- Abstract things of science are portrayed with pictures/photographs as well as proper description.
- Introduction of characters and symbols to make lesson easy-to-understand & attractive for the children.
- New scientific terminologies used in each chapter are highlighted with coloured and bold letters.
- Addition of glossary at the end of the textbook.

(2) Emphasis on problem-solving based learning

- The key questions highlighted as the core points of teaching learning in each lesson.
- Experiment related alternative equipment/teaching aids are suggested.
- Basic layout of textbooks follows the sequence of problem solving approach.
- Learning activities aimed at the acquisition of scientific process skills necessary for children to solve the problem.

(3) Enhancement of learning activities

- Introduction of a variety of experiments, demonstration, observation and investigation to promote the scientific attitude of the pupils.
- Introduction of the discussion activities to foster communication skills, expression ability and positive attitude of the pupils.
- Teaching aids are suggested in consideration with the relevance of the lesson outcomes and the availability.

Figure 2.1: The major feature of the revised primary science textbooks (NCTB, 2020)

Curriculum development is a continuous process. To meet the 21st century's challenges and make students unable to compete in the world the primary science textbooks were developed with a new approach based on a revised primary science curriculum (NCTB, 2012). There is the major feature of the revised primary science textbooks which is shown in Figure 2.1.

Based on the major refinements in the new primary science textbooks, this study identified nine key approaches which are used here. The approaches are-

1. Starting a lesson with a key question

Several kinds of literature have argued that starting a lesson with key questions is helpful for students' effective learning. Such a way of starting a lesson can engage students easily in teaching-learning activities (Cheesman, 2005). When a lesson starts by posing questions, it involves students to arouse their curiosity and engage them in further investigation (Rahat, 2007). Similarly, NCERT (2000) noted that starting a lesson with a question makes the learning interesting and allows students to explore, explain, extend, and evaluate their progress (NRC, 2000). Each lesson in new primary science textbooks is started with a key question. It is also clearly stated at the beginning of textbooks titled "Major refinements in the new primary science textbooks" in primary science textbooks. It (key question) provides the scope for students to investigate, observe/experiment, make hypotheses, and discuss (NCTB, 2020).

2. Exploring prior knowledge

Prior knowledge (also known as background knowledge) is a collection of "abstracted residue" that has been formed from all of life's experiences and it is a very important component for learning because it helps us make sense of new ideas and experiences. It helps to connect or glue new information to old (Schallert, 2002). Exploring one's prior knowledge can guide teachers to design appropriate teaching strategies, assist students to connect past experiences and new incoming information, and consequently enhance effective learning. It also helps teachers to know a student's alternative conceptions/misconceptions. Therefore, it helps teachers to work on students' conceptual change (Posner, 1982). There is an emphasis on presenting new lessons by relating

students' prior knowledge and experiences to new science textbooks (NCTB, 2020). Analyzing primary science textbooks, it is found that there are adequate scopes provided to explore students' prior knowledge in each lesson in new textbooks.

3. Real-life orientation in science concepts

To achieve the aims and objectives of the primary science curriculum science concepts need to be real-life oriented. Textbooks help students to make the connection between scientific and technological concepts and their application in the world outside of school and other real-life situations. Textbooks also support students in their understanding of fundamental concepts and big ideas that will enable and encourage students to use scientific and technological thinking throughout their lives. Real-life orientation of science concepts includes opportunities to engage in the development and practice of a variety of life skills to solve problems, make informed decisions and choices, to take appropriate actions to live meaningfully and successfully in a rapidly changing society. It not only focuses on knowledge, but also emphasizes the importance of the application of skills and values in real-life situations, participation in physical activity, community organizations, and initiatives (Jenkins et al., 2006), science classes should be related to children's experiences in the environment and daily life. At the elementary level, experiments, and observations are emphasized to be real-life oriented. Some of the contents of elementary level such as plants, animals, environment, foods, etc. Analyzing the new primary science textbooks, it is found that all chapters contain topics and examples that are particularly related to our daily life. Such as Our environment, materials, food, energy, natural resources, technology, first aid, etc. (NCTB, 2020). It is also clearly stated at the beginning of textbooks titled "Major refinements in the new primary science textbooks" in primary science textbooks that each lesson is presented by linking with real-life experiences.

4. Science process skills

Science process skills are considered a necessary tool to produce and use scientific information, to perform scientific research, and to solve problems. These skills can be gained by students through certain science education activities (Harlen, 1999; Huppert et al., 2002). Esler (2001) argued that modern elementary science curriculum emphasized two

major goals: (a) to enable children to develop science process skills for doing science and (b) to enable children to acquire appropriate science concepts or information. The reason for setting science process skills as a curriculum goal is they emphasized the intellectual value rather than the value of memorizing scientific facts or principles. They are effectively learned through conducting hands-on activities (Ostlund, 1992). Helgeson (1992) indicated that the most effective approach to teaching science is to integrate science process skills and science concepts using hands-on activities which focus on specific problem-solving skills. The definition of science process skills by the American Association for the Advancement of Science (AAAS) is-

➤ *Basic Science process skills*

Observing

Using time/space relationships

Classifying

Measuring

Communicating

Predicting

Inferring

Using number

➤ *Integrated science process skills*

Controlling variables

Interpreting data

Formulating hypothesis

Defining operationally

Experimenting

Formulating models

Basic skills involve lower thinking skills and are commonly developed in the lower grades. Integrated skills involve higher-order thinking skills and are commonly developed in higher grades. There are some activities in each lesson of new primary science textbooks for grades III, IV, and V (NCTB, 2020). These activities need to do investigation, observation, experiment, and decision-making. It is clearly stated at the beginning of textbooks titled “Major refinements in the new primary science textbooks” in primary

science textbooks that the key question provides the scope for students to investigate, observe/experiment, make hypotheses, and discuss. There is also stated that learning activities aimed at the acquisition of science process skills necessary for children to solve the problem.

5. Activity-based class

Several kinds of literature have argued that activity-based class affects students learning in science. The learner can learn through personal actions and experience and start developing their ideas about the world. They interpret things according to their thoughts and experiences. Activity-based teaching-learning helps them to construct their knowledge. According to Rillero (1994), a child best learns science by doing science. Doing science is not only limited to reading or hearing but it holds students in laboratory work to test ideas and develop understanding (Ewers, 2001). The prerequisite for this learning should be based on doing experiments or activities. If the learner is provided the opportunity to think and solve the problems on their own then the learning becomes long lasting. The important features of activity-based teaching-learning are that it is learner-centered and it encourages self-learning. It also allows the learner to study according to his/her ability and skills (Lakshmi, 2005). There are mentioned activities in each lesson in the new textbook to get the answer to the key question. It is also clearly stated at the beginning of textbooks titled “Major refinements in the new primary science textbooks” in primary science textbooks that the basic layout of textbooks follows the sequence of problem-solving approach (NCTB, 2020). This problem-solving approach requires an activity-based class.

6. Collaborative approach

The collaborative approach is essential to develop students’ 21st Skills (Wismath & Orr, 2004) and it is considered an essential tool when we deal with complex problems (Griffin et al. 2015). Besides, students learn well when they work collaboratively rather than individually work (Vygotsky, 1978). Analyzing the new primary science textbooks, it is found that there is mention to discuss with classmates as well as instruct group activities in all lessons. It is clearly stated at the beginning of textbooks titled “Major refinements in the new primary science textbooks” that introduction of group discussion activities to foster

communication skills, expression ability, and positive attitude of the learners. There is also introduced two characters to make the lesson easy to understand and attractive for the students as a part of promoting a collaborative attitude (NCTB, 2020).

7. Illustrations and diagram

Proper and relevant illustrations such as pictures or diagrams play a strong role as a tool for students learning. It helps the student to understand the concepts and makes them interested (Bishop, 1989). And also, by using appropriate diagrams, students can interact properly to concept (Thomas & Yoon Hong, 2001). It is stated at the beginning of textbooks titled “Major refinements in the new primary science textbooks” in primary science textbooks that abstract things of science are portrayed with pictures/photographs as well as proper descriptions. There are used a large number of illustrations, pictures, and diagrams in textbooks with proper labeling which are relevant to the concepts.

8. Scope of Scientific Inquiry

According to Anderson’s (2002) review of the use of inquiry in science education as defined by the Standards: scientific inquiry, inquiry learning, and inquiry teaching. Though there are distinct differences between each of these usages, all are closely linked. According to the Standards, scientific inquiry is the real work of scientists; it is what they do. Inquiry learning should reflect the essence of what is accomplished through scientific inquiry-how scientists learn about the natural world. Inquiry learning may be present in the school context as well as take place outside of the classroom. Inquiry teaching refers to the activities of students in which they develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world (NRC, 1996). Inquiry learning and inquiry teaching occur in the classroom, typically at the same time, and are often referred to as inquiry-based teaching (Southerland et al., 2007). Scientific inquiry refers to the combining of traditional science processes with scientific knowledge, scientific reasoning, and critical thinking to develop scientific knowledge as well as the development of science process skills (Venville & Dawson, 2004). The NRC (1996) advocated five features of inquiry teaching in science: creating scientific questions, the collection of evidence and observations, explanation of observations in connection to the

questions, evaluation of the explanations, and justification through communications of the explanations.

9. Lesson summary

During the mid-1970s and early 1980s, cognitive psychologists (Kintsch, 1974; van Dijk & Kintsch, 1983) made this clear in a series of studies with teachers, that summarizing strategies have a substantial average effect on student understanding of academic content. Several researchers found that using a summary effectively helps to increase students' understanding of content (Haystead & Marzano, 2009). Analyzing the new primary science textbooks, it is found that there is presented a summary in each lesson in new textbooks. It is also clearly stated at the beginning of textbooks titled "Major refinements in the new primary science textbooks" in primary science textbooks that each lesson is presented through grade-fitting simple texts and child-friendly summary.

2.1.4 Teacher's Edition (TE) for primary science teaching

The teacher's edition is a curriculum document that contributes to communicating with the curriculum. A teacher's edition is a way where curriculum writers can establish a direct link with the teachers, and clarify their intentions to them (Shkedi, 1995). It provides the content and activities to be conveyed to the students. Effective Teacher's Edition supports the teachers to understand the textbook pattern and implement it in the classroom as an implementation of the intended curriculum. Drake and Sherin (2006) stated that the teacher's edition has 5 key characteristics:

- communicating conceptual goals with direct links to suggested activities and support to help comprehend and implement the plan.
- Emphasizing pedagogical content knowledge.
- Offering practices and comprehension of relevant pedagogical activities.
- Presenting alternatives and freedom of choice
- Involving teachers in ongoing reflection.

Teachers generally use guides when the curriculum is new to them (Shkedi, 1995). The teacher's edition helps to scaffold the learning of teachers and think pedagogically on a particular topic considering students' needs. Richards (1998) stated that the teacher's

edition can function as a training manual for teachers by giving details advice on how to use a particular approach. The national education policy of Bangladesh has developed in 2010. The primary science curriculum has been revised in 2012 based on the national education policy to fulfill the demand of the national education policy. The aim of the primary science curriculum is-to assist a child in his/her physical, mental, emotional, social, moral, human, aesthetic, and spiritual development to instill in him/her patriotism, science-mindedness, and creativity, and inspire them to have a vision for a prosperous life (NCTB, 2012). To implement these aims and objectives primary science textbooks are developed with a new approach in 2013. A teacher's edition has also been published every year with textbooks at the primary level of Bangladesh. The teacher's edition is an essential tool to instruct teachers in delivering the new curriculum to schools in Bangladesh. The main education system is divided into three levels in Bangladesh: 1. Primary Level (Class 1–5) 2. Secondary Level (Class 6-12) 3. Tertiary Level In the primary level for grades 1 and 2, The instruction guide for teachers is called Teacher's Guide. For grades 3-5 it is called Teacher's Edition. The Teacher's edition includes a key question first, and then the teaching-learning activities, expected science process skills, attitudes and values, and sample question to assess students' understanding is given sequentially.

2.1.5 Supporting Personnel for primary teachers' professional development

The primary education system of Bangladesh is managed by a central authority. In a centralized management system, it is hard to communicate with teachers and schools properly. The upazila education office (UEO), primary teacher training institute (PTI), and upazila resource center (URC) are directly involved in teachers' professional development. Among them, UEO and AUEO have had actual classroom experience as they visit schools directly, but their training and backgrounds do not always make them qualified supervisors (Chowdhury et al., 2002). The assistant upazila education officers (AUEO) are the frontline for primary schools for giving teachers professional support (Education Watch, 2004). The primary teacher training institute (PTI) and upazila resource center (URC) are responsible for the improvement of teachers' performance at the school as they are directly engaged in teacher training. Both organizations work on teacher development and supervision, but there are differences. The PTI is academic, and they always deal with fundamental theories

and different new innovative approaches to education. Primary teacher training institute (PTI) is located in 64 districts of Bangladesh, and these are 56 (54 govt. and 2 non-govt.) in number. The URC deals training with short-term issues; that arise in the time of teaching practice in the classroom.

Role of PTI instructors (PTII)

In Bangladesh, PTII's conducted a yearlong C-in-Ed (Certificate in Education) course; and that was planned for non-trained government and nongovernment primary school teachers. They also DPED training for in-service primary teachers' professional development. PTII aimed to enhance teachers' in-service professional skills. Specifically, PTI instructors performed as teacher supervisors for teachers' professional development. Especially, they provide pedagogical suggestions to teachers in the classroom. They observe the classroom performance of trainee teachers and identify the level of achievement and provide supportive feedback to trainee teachers (DiPE, 2012). Sometimes they also act as a mentor to qualify trainee teachers to achieve the expected level of performance (DPE, 2012).

Role of URC instructors (URCI)

Upazila Resource Centre (URC) is a new addition to the Bangladesh govt. for meeting the demand of teachers' constant professional development needs (MoPME, 2003). The URC deals with the feasibility of educational short-term issues; that arise in the period of classroom practice. Many countries have such types of centers with different names. However, URC acts towards development and support, rather than control and permit the schools to benefit from each other's experiences and expertise" (Supervision Module-3, 2007). URC very often provides academic services to primary schools at the local level and assists teachers to improve their teaching and learning. URC also acts to attain the skills of school management and disseminate information school managing committee. Along with these, URC also facilitated teachers to conduct action research, administer the URC library with technical assistance, and generate opportunities for teachers to learn more about their profession (MoPME, 2003). URC instructors and assistant instructors both are responsible for observing teachers' class performance regularly. They conduct it according to a structured observation form which is centrally approved by the authority. They collect and submit the report and provide it to the PTI superintendent monthly. The PTI

superintendents evaluate the report and provide suggestions to URC personnel regarding teachers' performance. Then, they provide support to the primary teachers according to PTI superintendents' instruction. It is like a cycle run by URC instructors or assistant instructors. URC instructors and assistant instructors are responsible to arrange subject-based short-term training for teachers to improve their skills and pedagogy on a particular subject. Consequently, they arrange refresher training for primary teachers. Besides training URC instructors and assistant instructors are also responsible to publish a booklet, primary education bulletin, and monthly newsletter focusing on local primary school teachers. Besides these, they are also responsible to conduct surveys for designing a training plan for teachers (MoPME, 2003). At the same time, they also attend meetings, and workshops and act following the instruction of higher authority.

2.1.6 Assessment Guide

Assessment guides provide the needed instruction for formative and summative assessment. AG includes the assessment areas, tools, assessment techniques, and way of giving feedback for formative assessments. In the case of summative assessment, AG provides assessment areas, tools, techniques, rubrics, etc.

2.2 Inquiry in Science Education

The NRC provides its definition of inquiry. Inquiry is a set of interrelated processes by which, scientists and students pose questions about the natural world and investigate phenomena: in doing this, students acquire knowledge and develop a rich understanding of concepts, principles, models, and theories (NRC, 1996). A key aim of science education is students' understanding, not memorized facts, and knowledge. The inquiry has an important role in developing understanding since it involves learners making sense through their actions, thinking, and reasoning in various aspects and inquiry-based science education promotes both conceptual understanding and the development of capabilities such as critical thinking, collaborative working, consideration of alternatives, effective communication (Harlen, 2014). Inquiry-based learning approach in the classroom helps the students to plan and conduct a course of action to find out the answers to their questions by themselves. Inquiry learning involves developing questions, making observations,

doing research to find out what information is already recorded, developing methods for experiments, developing instruments for data collection, collecting, analyzing, and interpreting data, outlining possible explanations, and creating predictions for future study. Specific learning processes that people engage in during inquiry-learning include: (Bell et al., 2010).

- Create questions of their own
- Obtain supporting evidence to answer the questions
- Explain the evidence collected
- Connect the explanation to the knowledge obtained from the investigative process
- Create an argument and justification for the explanation Inquiry-based teaching strategies are an excellent tool for educators.

By using this approach teachers easily connect with their students. There are 4 different types of inquiry instruction-

Structured Inquiry

Structured Inquiry is along with the traditional teaching methods. Teachers lead the students as they work through the process as a class together.

Controlled Inquiry

Controlled Inquiry is done within a framework that is established by the teacher. The teacher provides the students with the context, starting ideas, tools, and perhaps even some goals. After then the students apply what they are given and move through the process steps.

Guided Inquiry

Guided Inquiry involves the teacher providing the topic or questions, then the students are left to develop their methods of inquiry.

Free Inquiry

Free Inquiry involves the student's taking ownership of their learning, including topic selection, questions, methods, and goals. To clarify this topic here is a framework for different types of inquiry with 5 key features of inquiry-based teaching which is adopted

by the NRC (2000). (Adapted from: National Research Council [2000]. Inquiry and the National Science Education Standards, A Guide for Teaching and Learning. Washington, DC: National Academy Press, P. 29).

Table 2.1: Types of Inquiry

Five Essential Features of Inquiry	Structured inquiry	Controlled inquiry	Guided inquiry	Free or student-centered inquiry
1. Learner engages in a scientifically oriented question	Questions provided by the teacher, materials, or other sources	Learner sharpens or clarifies questions provided by the teacher, materials, or other sources	The learner selects among questions, poses new questions	The learner poses a question
2. Learner gives priority to evidence in responding to a question	Data provided by the teacher and told how to analyze	Data provided by the teacher and asked to analyze	Learner directed to collect certain data	Learner determines what constitutes evidence and collects it
3. Learner formulates explanations from evidence	Evidence provided by the teacher	Learner gave possible ways to use evidence to formulate an explanation	Learner guided in the process of formulating explanation from evidence	Learner formulates explanation after summarizing evidence
4. Learner connects explanation to scientific knowledge	All connections provided by the teacher	Possible connections provided by the teacher	Learners directed toward areas and sources of scientific knowledge	Learner independently examines other resources and forms the links to explanations
5. Learner communicates and justifies explanations	Steps and procedures for communication provided by the teacher	Broad guidelines to sharpen presentation provided by the teacher	Learner coached in the development of communication	Learner formulates reasonable and logical arguments to communicate an explanation

In the National Primary Science Curriculum 2012 in Bangladesh Inquiry-based teaching-learning has given more emphasis to making the student familiar with scientific understanding and concepts. It encourages students curious about natural phenomena. Our science books and Teachers' Editions are also reformed in an inquiry-based approach. Our books follow structured inquiry and classroom also. There is an emphasis on presenting new lessons by relating students' prior knowledge and experiences to new science textbooks (NCTB, 2020). Analyzing primary science textbooks, it is found that there are

adequate scopes provided to explore students' prior knowledge in each lesson in the new textbook.

2.2.1 Inquiry-based teaching

Considering the importance of inquiry-based teaching in science education, 'National Science Education Standards of America proposed five essential features for inquiry-based teaching (NRC, 2000)

- ***The learner engages in scientifically oriented questions.***

The first of the essential features focuses on a scientifically oriented question that precedes and drives the activity. In other words, the question provides the driving purpose for pursuing the investigation.

- ***The learner gives priority to evidence in responding to questions.***

The second essential feature is that learners collect and evaluate evidence, which allows them to develop and evaluate explanations that address the initial scientifically oriented question(s). Empirical evidence is the element that sets science apart from other subjects of inquiry.

- ***The learner formulates explanations from evidence.***

The third essential feature describes the path from evidence to explanation. Forming explanations is the way an individual learns about something unfamiliar or unknown by relating the evidence they gather to what they already know. Drawing explanations from evidence deepens students' current understanding so they better see and know the natural world around them.

- ***The learner connects explanations to scientific knowledge.***

The fourth essential feature is that learners evaluate their explanations in light of existing scientific knowledge. Once a scientific explanation is developed, it must be evaluated. Learners then review alternative explanations as they engage in dialogues with each other, compare results or check their results with those proposed by the teacher, other experts, or instructional materials. Through the process of evaluation, an explanation that is commonly

agreed upon by all learners emerges. Learners connect their results to the scientific knowledge appropriate to their level of development. Thus, learners should reach conclusions that are consistent with currently accepted scientific knowledge.

- ***The learner communicates and justifies explanations.***

Lastly, the fifth essential feature is that learners communicate and justify their proposed explanations. In having students share their explanations, others can ask questions, examine the evidence, identify faulty reasoning, point out statements that go beyond the evidence, and suggest alternative explanations. By sharing their explanations, students eventually become more confident with their conclusions. These features of inquiry-based teaching have been used in this study to explore the existing primary science teaching practiced toward inquiry.

Inquiry-based teaching is an approach to teaching. Avsec and Kocijancic (2014) stated that inquiry-based teaching has an effective teaching approach in education. Conner (2015) indicate that the proper understanding of inquiry-based teaching support teacher to be more effective in planning, teaching, and learning process. Driver (2011), and Isaac and Clara (2019) found that teachers who practice inquiry-based teaching in the classroom, improve teaching and students' achievement of learning outcomes (ILOs). Inquiry-based teaching is useful to achieve ILOs. Teachers did not comprehend inquiry-based teaching which may prevent teachers to improve their teaching and students' achievement of ILOs, and that may influence them to hardly practice or not practice inquiry-based teaching in the science classroom. Ababio and Dumba (2014), found that teachers were not practicing inquiry-based teaching because they did not have the expertise regarding inquiry-based teaching.

Subba et al. (2019) conclude their study that inquiry-based teaching has an important effect on students' achievements of ILOs as it helps to enhance students' interests, positive attitudes, and achievement in science. They further added that inquiry-based teaching can provide learning opportunities that help students learn to investigate, construct assertions, and justify those assertions in the classroom community. Similarly, Williams et al. (1998) found that inquiry-based teaching can help gain a greater conceptual understanding of science. Moreover, Saunders-Stewart et al. (2012) concluded that inquiry-based teaching

provides opportunities for students to develop knowledge and skill, increased intrinsic motivation, development of expertise, self-efficacy, task commitment, positive attitudes about learning, competence or expertise, and greater creativity.

Inquiry teaching refers to the activities of students in which they develop knowledge and understanding of scientific ideas and also develop an understanding of how scientists study the natural world (NRC, 1996, p. 23). Scientific inquiry involves the combining of traditional science processes with scientific knowledge, scientific reasoning, and critical thinking to develop scientific knowledge as well as the development of science process skills, attitudes, and values (Venville & Dawson, 2004). Therefore, adequate knowledge of inquiry-based teaching developed students' science process skills, attitudes, and values as well as critical thinking for scientific inquiry. It is found from the study of Kuhlthau et al. (2007); Littky and Grabelle, (2004), and Wiggins and McTighe, (1998) that inquiry teaching provides opportunities for students to focus on learning through questioning and reflection skills. The teachers of the study did not comprehend inquiry-based teaching which led them not to give learning opportunities to the students for inquiry in the science classroom; which may hinder students understanding of science.

The study of Harvey and Daniels (2009); Jacobs (2010); Kuhlthau et al. (2007); and Littky and Grabelle (2004) settled from their study that, inquiry teaching provides the inquiry skills that are aligned with methods of learning, which have been referred to as problem-based learning, authentic learning experiences, investigative processes, learning through lenses, critical thinking. Blanchard, Southerland et al. (2016) determined from the study that, inquiry-based teaching allows teachers to make students determine about problems, about the challenges and issues they investigate, and helps to move the students into a more meaningful engagement and deeper learning. Cooper and Murphy (2016) suggested from their study that, an adequate understanding of the teacher must provide a classroom that rests upon positive connections between the teacher and the student, positive relationships between peers, ample time for students to speak with one another, and a classroom that fosters empathy to engage students in effective inquiry. Liu and Smith (1998) found that IBL can help gain a greater conceptual understanding of science.

2.3 Challenges to Implementing Inquiry in Science Teaching Practice

As a teaching method despite its numerous benefits, an inquiry has some obstructions which always limit its practice. International studies indicate that teachers are challenged to implement inquiry-based teaching-learning in a science classroom (Gallagher, 1989; Edelson et al., 1999). The meaning and interpretation of inquiry-based teaching-learning are a major concern that which activities do, and which do not constitute inquiry. However, teachers of all four cases did not comprehend inquiry-based teaching; and had different perceptions of what inquiry-based teaching-learning entails. Bell et al. (2005) view that if the students are not involved in the analysis of data to generate the answer to the question, the activity may be simply referred to as a hands-on activity rather inquiry. However, teacher guidance and support for optimal learning gain are also dependent on teachers' understanding. Teacher knowledge and understanding of inquiry-based learning provide direction and motivation to students to conduct scientific investigations (Connor, 2016; Østergaard, 2016). Researchers documented that many science teachers do not have the requisite knowledge needed to implement inquiry-based teaching; and this has become a barrier to successfully implementing this pedagogy (Crawford, 2000; Kang et al., 2008; Keys & Kennedy, 1999; Wallace & Kang, 2004; Windschitl, 2004).

The most rational level of appropriate guidance must reflect in the inquiry process with a balance between learners and teachers, and the level of guidance and support depend on who is responsible for the inquiry activity. The instructor who becomes a facilitator in inquiry teaching may provide vital kick-starter guidance on a minimal scale that is appropriate to learners (Blanchard et al., 2010). Costenson and Lawson (1986) view that teachers do not prefer inquiry-based methods as time is needed for an inquiry-based science lesson preparation for learners' meaningful exploration and discussion in class. Time management is a vital issue for the teachers to not practice inquiry in this study. Capps and Crawford (2000) mentioned that teachers having lack of understanding inquiry-based learning will have little to no interest in conducting the inquiry approach in their classrooms. This type of teacher will skip the inquiry approach in the classroom. Research has shown that short-term training of teachers on inquiry instruction did not changes teachers' practice (Yoon et al., 2007). Teachers with great knowledge and competence are

an asset and leave a positive impact on the student's accomplishments (Harlen, 2014). Therefore, for sustainability professional development programs should be an all-year-round program, with monthly regular workshops, weekly meetings, and daily co-teaching followed by interrogation. It will take establishing and promoting collaborations among teachers with the support of the administration.

The commitment of stakeholders to work towards the implementation of inquiry-based learning as an approach to science learning. Good teachers of science allow students to follow their interests and try to find answers to questions posed by themselves in implementing inquiry-based learning, (Gatt & Zammit, 2019). Walker (2007) stated lack of resources is one of the problems that might hamper the interest in inquiry-based teaching by teachers. Teachers of this study prefer the traditional direct teaching method as they do not have enough support for innovative pedagogies. Physical resources play a supportive role as they allow teachers to improve the lesson by taking part in practical experiments using the proper tools and equipment (Wellcome Trust, 2015). Besides this, teachers need the necessary equipment in a required quantity; classroom and lab facilities; access to outside space; and ICT and technical support to implement inquiry successfully. Teachers having a lack of resources may not boost their confidence and self-efficacy.

Dixon and Worrell (2016) asserted that two types of assessment complement each other although they have different purposes. Literature suggests that assessment helps to improve teachers' quality of teaching in classrooms, and helps to achieve students' ILO (Biggs, 2003; Hargraves, 2007; Iron, 2008; and Jones, 2005). Summative assessment may not be helpful for inquiry-based learning as inquiry skills need direct observation to assess. However, Jonathan's (2012) study indicated that inquiry-based learning requires more formative forms of assessment. Gronlund's (2006) study on educational assessment revealed that traditional assessment practices need less time and low-level thinking of students which has less impact on student's achievement. Crystal (2012) found in the study that teachers faced challenges to monitor students' behavior and keeping them on task, especially in larger classes. Teachers of large class sizes faced the challenge and may be demotivated to practice inquiry in the science classroom. Senior teachers could provide experiential suggestions to others with their teaching experiences, content and pedagogical

knowledge (Brickhouse & Bodner, 1992). School authorities can arrange formal and informal learning communities for teachers to exchange teaching ideas. Teachers need support from other teachers to share and solve different aspects of teaching-learning (Darling-Hammond & Baratz-Snowden, 2005).

Adam and Krockover (1997) found in their study that, when teachers can connect the curriculum instruction with inquiry-based teaching, they become more confident to do inquiry. Teachers having less understanding of inquiry-based teaching, lose their interest to introduce inquiry in science classrooms (Capps & Crawford, 2013). Inquiry requires a higher level of motivation for both teachers and students; due to a lack of sufficient motivation, they lose their interest to participate or participate in a disengaged way (Edelson et al., 1999). Soloway et al. (1994) recognized motivation as a prime challenge for Learner-Centered teaching. The scientific inquiry needs a level of accuracy and care that are needed for students' science learning (Edelson et al., 1999). Soloway et al. (1994) reported that tools needed for inquiry must be accessible to learners and align with their abilities and prior experiences. Students are not naturally asked to manage extended complex processes as part of their traditional learning activities (Edelson et al., 1999). They added that, if they are unable to organize activities and manage an extended process whenever necessary, students cannot engage in open-ended inquiry and cannot achieve the goal of inquiry-based learning. The technologies and activities of inquiry-based learning must be suitable for the practical obstacle of the learning environment like available resources and fixed schedules (Edelson et al., 1999). Teachers faced practical constraints in the learning context to do inquiry, which is a vital challenge for inquiry practice.

2.4 Concept of Constructive Alignment

Constructive alignment (CA) was first described by Biggs (1996) as a teaching and learning strategy where learning objectives are explicitly defined and represent the intended learning outcomes (ILO) of the course. The theory of constructive alignment describes how learning outcomes should be achieved through teaching, learning, and assessment activities that provide opportunities for learners to achieve and demonstrate the ILOs. Consideration of this concept in greater depth uncovers two fundamental aspects (Biggs, 2003). The second aspect to consider is alignment (Biggs, 2003), which is the role of the teacher in

ensuring all learning activities are appropriate and therefore allow students to meet outcomes. The ILOs require higher-level cognitive skills; the teacher must provide learning activities that foster the development of such skills. In addition, the learning environment must support this development, and students are required to demonstrate the ILOs through appropriate assessments. Alignment of teaching, learning, and assessment with the ILOs results in the learner being ‘trapped’ and unable to escape without learning what was intended (Biggs, 2003). Within CA learning outcomes are explicitly defined and made available to the student. There is a greater emphasis on the student to enable effective learning to take place rather than the activities of the teacher (Biggs & Tang, 2011).

2.4.1 Alignment in Curriculum

The alignment of the curriculum can be defined in several ways. Tyler (1949) indicates that alignment occurs when the curriculum offered across the grades builds and supports what has already been learned in earlier years. Biggs (2014) emphasizes the importance of alignment of assessment with the curriculum objectives and agrees with Ramsden (2003) that assessment is the curriculum for the students. To some extent, the student will learn what is being assessed as much as what is in the curriculum. Biggs (1999) asserts that assessment should be designed in such a way that if students focus on the assessment, they will be learning what the objectives say they should be learning” (p. 68). This view of the vital place of assessment in curriculum alignment is supported by La Marca et al. (2000), who contend that the alignment process must consider the assessment of student learning to be the key indicator of alignment. According to La Marca et al. (2000), alignment is the degree to which assessments yield results that provide accurate information about student performance regarding academic content standards at the desired level of detail to meet the purpose of the alignment system in a manner that conveys student proficiency as it relates to the content standards. According to Biggs (1996), aligning desired outcomes to the selected learning activities and the associated assessment is a crucial element of good teaching. He emphasizes the need for this alignment in curriculum design, which he labels constructive alignment. Biggs (1996) holds a constructivist view, believing that meaning is not imposed or transmitted by the teacher, but rather it is created by the students’ learning activities and assessment. Biggs (1996) asserts that for students to be meaningfully engaged

and bridge a learning gap, the curriculum needs to be focused on what the students can do. From this focus, the curriculum is then designed so that the desired outcomes, teaching-learning activities, and assessments align.

This constructive alignment in curriculum development incorporates a design process, where first of all the outcomes of the course are identified in terms of what the students should be able to do it after the program. This is usually expressed as a series of verb statements about what the student will be able to do as a result of the curriculum. Then, the gap between what the students understand or can do before they undertake the course and what they are expected to be able to do as a result of the course is identified. Once the learning to be undertaken has been identified, the curriculum is designed in such a way as to allow students to confront their prior understandings and make adjustments to their skill set based on carefully designed activities. It is important to note that Bigg's (1996) believes that the students should be engaged in the learning activities, implying that the activities need to hold student interest and provide a cognitive challenge. A student's progress through the curriculum is then tracked by using assessment tasks that are strongly aligned with the course's intended outcomes, providing the teacher with the information necessary to adjust the experience in the classroom to better allow the student to reach the intended goals. Essentially, the constructive design process focuses not on what teachers do but on what outcomes the student will achieve. Using the above example, a constructively designed course will focus on the development of student understanding and skills in the pursuit of the ability to apply the Law of Reflection. Conversely, a course not designed constructively may simply describe a series of activities a teacher can utilize in the teaching of the Light topic. This allows the teacher to move away from a coverage-focused instructional model, where the purpose of the teacher is to deliver a set number of pages from a textbook in a certain time and be a more responsive tutor or coach for the students. By keeping the focus of the learning in the classroom in keeping with the program's intended goals, both teacher and learner are more focused on what needs to occur in the classroom for the goals to be achieved.

Biggs (1996) presents constructive alignment in a form that seems complementary to the backward design process presented by Wiggins and McTighe (2001). Like Biggs

(1996), Wiggins and McTighe (2001) recognized the increasing prevalence of coverage teaching in which the aim is simply to get through a certain amount of material in a certain amount of time, with little emphasis on whether a student has learned anything by the time the course is completed. They refer to this style of teaching as “Teach, test, and hope for the best” (p. 5). In recognizing the limitations of this style of teaching, Wiggins and McTighe developed a style of curriculum design called backward design. Each step of the backward design process involves a focusing question:

- What is worthy and requires understanding?
- What is evidence of understanding?
- What learning experiences and teaching promote understanding, interest, and excellence? (Wiggins & McTighe, 2001)

Biggs’ model of constructive alignment (Biggs, 1999; Biggs & Tang, 2011), based upon constructive learning theory (constructivism) and aligned curriculum, aims to enhance student learning outcomes by focusing on what the student does. Constructive alignment aims to encourage students to use deep, rather than surface, approaches to learning. The focus on the central role of the learner in building meaning is derived from constructivist learning theories (Steffe & Gale, 1995; Jonassen, 1991; Vrasidas, 2000), whilst the alignment of assessment, teaching, and learning activities, has its foundation in instructional design literature (Tyler, 1969; Cohen, 1987; Ramsden, 2003). Biggs’ model is student-focused, with clear and intentional alignment of assessment, teaching and learning activities, and unit objectives.

Aligned Curriculum Tyler (1969) defined curriculum alignment as occurring when material learned in earlier years is built upon and supported in subsequent classes. Tyler’s aligned model consisted of four major steps (1) identifying objectives, (2) choosing appropriate learning experiences, (3) organizing these experiences to maximize learning, and (4) evaluating the resulting learning. These four steps were always aligned, with objectives matching experiences and assessment tasks. The work (Ramsden, 2003) indicates that this alignment can be achieved as long as the assessment matches objectives; from the student’s perspective, the curriculum is always defined by the assessment. The benefits of an aligned curriculum can be related to the work on approaches to learning. One

of the identified requirements for positive learning environments was the clear communication of expectations to students. In an aligned curriculum, the teaching and learning activities match the assessment tasks and help provide the clarity of intention required to encourage students to engage in deep approaches to learning. The impact of aligning teaching and learning activities and assessment tasks was highlighted by Cohen (1987). In discussing instructional alignment Cohen (1987) reported students achieved significantly better results when the teaching was aligned to the assessment than with non-aligned instruction. This is in line with expectations if an aligned curriculum is likely to help engage students appropriately with learning tasks.

An aligned curriculum forms the second pillar of constructive alignment. Biggs (1996) proposed the alignment of teaching and learning activities and assessment tasks to a unit's intended learning outcomes. Intended learning outcomes capture unit 1 goals in terms of cognitive activities students will be able to perform by the end of the unit. Biggs' work claimed that this use of an aligned curriculum with constructivist learning theories results in a student-centered learning environment and a clear focus and consistent message.

2.4.2 Intended learning outcomes

According to Mahajan and Singh (2017), a proper understanding of intended learning outcomes (ILOs) helps the teacher to develop quality teaching by planning a lesson, giving a clear idea of what and how much to teach, and planning accordingly, by designing their teaching material more effectively, by selecting appropriate strategies for teaching, by avoiding extra teaching which ultimately helps in saving time. Mahajan and Singh (2017) also added the clear concept of learning outcomes helps teachers to make assessment mapping clear and easy; to measure the effectiveness of the unit, play a role in the allocation of marks in developing question papers, focus on the questions on what students should be learning and how they are going to teach this; to make evidences like rubrics, charts or graphs related to summative and formative assessment. Gronlund and Brookhart (2009) suggested that, the proper conception of teacher about ILO help them to identify knowledge, skills, and attitudes that students should develop through their course; to select and organize the lesson content, activities, and teaching-learning strategies that students will need for achieving the ILOs; to design assessment and feedback strategies that are

aligned with the ILOs; to map their curricular outcomes for a program or accreditation standard.

Constructive alignment directly addresses the ILOs by formulating teaching-learning activities and subsequent assessment tasks. Learning outcomes are the statement of what students should be able to do, know and understand at the end of the learning (Dillon). Learning outcomes are statements of what a student is expected to know, understand, and/or be able to demonstrate after completion of learning (Adam, 2004; Battersby, 1999; Bingham, 1999; Donnelly & Fitzmaurice, 2005; ECTS Users' Guide, 2015; Gosling & Moon, 2001; Jenkins & Unwin, 2001; Kennedy et al., 2007; Moon, 2002; Ramsden, 2003). Learning outcomes express what students can demonstrate in terms of knowledge, skills, and attitudes after course completion and lead instructors to focus on a broad synthesis of abilities that combine knowledge, skills, and values into a whole that reflects how people use knowledge (Battersby, 1999).

2.4.3 Learning activities

Successful learning is the vital aim of teaching-learning. Biggs (2003) suggests three important questions for designing teaching-learning in the classroom.

- What should the student be able to perform at the end of the learning experience?
- What activities should be undertaken to learn?
- How can the teacher find out if the student has learned successfully?

The teaching-learning focus on activating the verbs in the ILO statements. The most efficient way the students can achieve the outcomes is to enact the same verbs the outcomes themselves require (Biggs, 2003). Teaching learning activities should allow students to involve themselves in activities, and develop their knowledge, understanding, and skills in various ways (University of Tasmania, 2018). There are many ways in which learning activities in classrooms can be organized (Biggs, 2003). Helmke (2012) suggests teachers must give the student adequate time to practice and gradually introduce new learning in their classroom.

2.4.4 Assessments

Another important aspect of the curriculum is the assessment associated with it. Dochy and McDowell (1997) describe assessment as a tool to determine a student's progress rate against both individually negotiated goals and previous performances. This relates well to the definition presented by Wiggins and McTighe (2005) that assessment involves "the determining of the extent to which the curricular goals are being and have been achieved" (p.3) i.e., summative assessment. Assessments can also be both diagnostic and formative and are used to inform teaching and learning. Hattie (2003) argues that the assessment data is most important when we:

Move away from considering achievement data as saying something about the student, and start considering achievement data as saying something about their teaching. If students do not know something, or cannot process the information, this should be a clue for teacher action, particularly teaching differently.

This view of assessment, as being an indication of how teaching must be changed in response to the student data is supported by Black and Wiliam (1998), who consider formative assessment to involve four elements:

1. establishing a standard or expected level of performance
2. gathering information on a student's current performance
3. develop a process to compare the two performance levels
4. adjusting teaching to alter, or rather close, that gap

Essentially, Black and Wiliam (1998), and Hattie (2003) argue that formative assessment can, and should, be used as a source of feedback to improve both teaching and learning. In this vein, it is important to note that a single assessment can fulfill a number of purposes. An assessment tool can be both summative and formative. For this case study of alignment, the analysis addresses the extent to which summative assessments are aligned with goals and learning tasks.

Assessment is the process of gathering and discussing information from multiple and diverse sources to develop a deep understanding of what students know, understand, and can do with their knowledge as a result of their educational experiences (Huba & Freed,

2000). The assessment tasks must mirror the Learning Outcomes since, as far as the students are concerned, the assessment is the curriculum: “From our students’ point of view, assessment always defined the actual curriculum” (Ramsden, 2003).

2.5 Assessment and Curriculum

Assessment is an important part of the curriculum because “through our assessment, we communicate most clearly to students’ which activities and learning outcomes we value” (Clarke et al., 1990, cited in Clarke, 1992, p. 24). According to Tamir (1987), the relationship between the curriculum and assessment is: “While in theory, the curriculum should determine the nature of testing, in practice quite often the testing requirements determine what teachers teach and what students learn. No wonder traditional testing procedures have often been accused of exerting adverse effects on curriculum reform. On the other hand, when used wisely, tests have been proven to play an important role in implementing curriculum reform.

Assessment must be valid and must seek to measure and report on the learner’s progress and achievements throughout all aspects of the science curriculum. The assessment techniques in science must focus on knowledge objectives, understanding of scientific concepts, competence in the application of understanding of scientific concepts, and competence in the application of attitudes. Assessment practices also communicate what is important and what is valued in science education. Assessment practice in the science classroom: Assessment is a tool to determine a student’s progress rate against both individually negotiated goals and previous performances. According to Wiggins and McTighe (2005), assessment involves determining the extent to which the curricular goals are being and have been achieved, i.e. summative assessment. Black and William (2009) interpreted the term formative assessment as “encompassing all those activities undertaken by teachers, and/or by their students which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged” (p. 8).

Several studies have been undertaken to determine whether the assessment is aligned with the goals of a particular curriculum. From these studies a large number of alignment methods have been developed, ranging in complexity and usefulness. Bhola, Impara and Buchendahl (2003) classify alignment methods into three broad categories:

low, moderate, and high-complexity models. Low-complexity models are simple alignment frameworks that define alignment as “the extent to which the items on a test match relevant content standard” (p. 22). Moderate complexity models recognize that alignment is generally defined as more than just a content match, and also examine cognitive complexity such as item difficulty. Finally, the high-complexity models consider cognitive complexity, congruence across years, content, and a range of other factors (Bhola et al., 2003).

The American Academy for the Advancement of Science developed a moderate complexity program called Project 2061, whose goal was to analyze science materials for the depth of science concepts and skill provision. Stern and Ahlgren’s (2002) investigation of Project 2061’s method for determining alignment analyzed a range of assessment materials for their alignment and validity according to three distinct criteria: alignment to curriculum goals, testing for understanding, and informing instruction. The content analysis used a large variety of criteria, particularly focusing on test-based materials such as textbook quizzes and commercial term papers, and suggested methods to improve the alignment of assessment tasks.

2.6 Alignment of Learning Outcomes with Learning Activities and Assessment: A Theoretical Framework

In education, learning outcomes, teaching-learning activities, and assessment are inextricably related and their alignment or high consistency has been crucial for achieving the goals of education and this connection among the three helps to make the overall learning experiences more transparent (Biggs, 2014). It is important to ensure that the curriculum, assessment, and instruction in the science program are aligned, as the research literature indicates that constructive alignment enhances learning outcomes (Biggs, 2011). John Biggs (1999) suggests that effective teaching and learning require a careful alignment of intended learning outcomes, learning activities, and assessment. This study followed the framework proposed by John Biggs (1999) to explore the existing alignment of primary science teaching practice towards inquiry and its effect on developing curriculum documents.

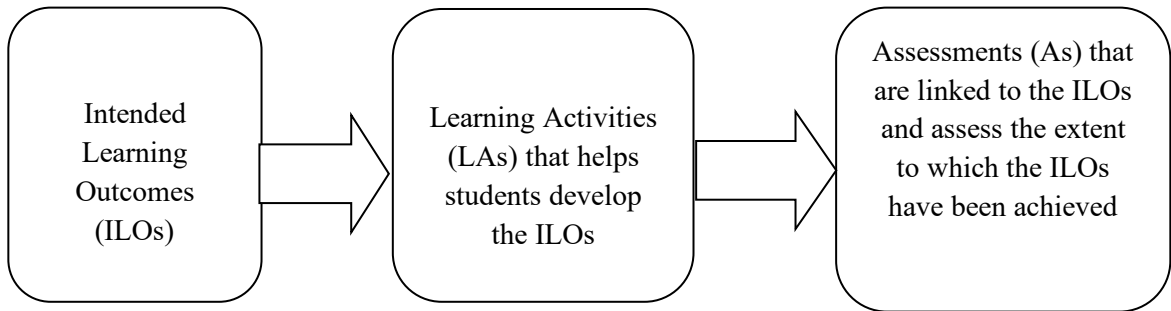


Figure 2.2: Alignment of learning outcomes with learning activities and assessment (Biggs, 1999)

2.7 Chapter Summary

This chapter has discussed different literature regarding issues supporting this study. The literature included the issues of constructive alignment in the primary science teaching practice in Bangladesh. In the end part of the chapter, the theoretical framework has been discussed where ILOs, LAs, and As are aligned in education. The next chapter addressed the methodological details of the study.

Chapter Three: Methodology

This study aimed to explore the existing constructive alignment in primary science teaching practice towards inquiry and its effect on developing curriculum documents. To address and explore the aims, this chapter discusses the research design and methodology employed in this study. It first readdresses the research questions, then discusses the conceptual framework, and philosophical worldview. This chapter further deliberates the research's various stages, including the strategy of inquiry, specific research design, source of data, instruments, data collection process, and data analysis technique; and justification for using these designs. Finally, the chapter describes the trustworthiness throughout the research process, the ethical considerations that informed this study, and the methodological challenges and limitations.

3.1 Restating the Research Questions of the Study

The central research question explored in this study is:

How does the situation of existing constructive alignment towards the inquiry approach effects the development of primary science curriculum documents?

In order to respond to this central question, a number of sub-questions were posed:

1. How do primary science teachers comprehend the focus of intended learning outcomes in line with inquiry-based teaching?
2. How do primary science teachers comprehend the approaches of primary science textbooks and teacher's editions to facilitate inquiry-based teaching?
3. How learning opportunities of inquiry-based teaching are practiced in the science classroom?
4. How do primary science teachers perceive the practiced assessment methods to achieve the intended learning outcomes?
5. How do primary science teachers perceive students learning towards achieving the intended learning outcomes?
6. What challenges do primary science teachers face to practice inquiry in the science classroom?

7. What is the effect of existing constructive alignments on developing curriculum documents?

3.2 Conceptual Framework of the Study

A conceptual framework is a system-defined as a functionally integrated set of elements- in the sense that it serves as an integrating mechanism that works within and across the “concepts, assumptions, expectations, beliefs, and theories” that guide research (Maxwell, 2013, p. 39). However, the conceptual framework can become a mechanism and strategy for aligning researchers’ goals, expectations, values, and ideas about research at its outset and throughout the process (Miles et al., 2014). Ravitch and Riggan (2016) stated that, conceptual framework is the alignment of analytic tools and methods that helps to increases a study rigor and validity. Therefore, a conceptual framework was developed to guide this study that systematically orders the phenomena being investigated (Figure. 3.1).

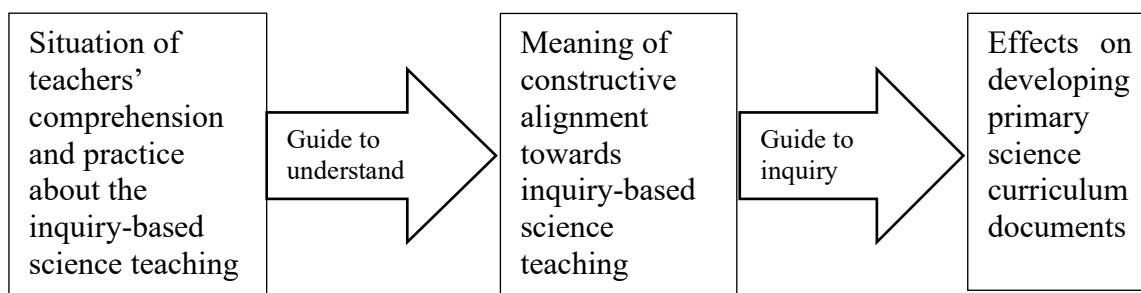


Figure 3.1: Schematic diagram of the conceptual framework

The existing situation of primary science teaching practice was explored through teachers’ comprehension and classroom practice. This situation guided the study to understand the existing constructive alignment in primary science teaching practice towards inquiry. The constructive alignment guided the study to inquire the effects on developing curriculum documents.

3.3 Philosophical Worldview: Social Constructivism

Philosophical worldview refers to the philosophical ground of the research (Kuhn, 1970); or the researcher’s ‘worldview’ (Mackenzie & Knipe, 2006) which means “a basic set of beliefs that guide research action” (Guba, 1990, p.17; cited in Creswell & Creswell, 2018).

A worldview is a general orientation of the world and the nature of the research that a researcher holds (Creswell & Creswell, 2018; Mertens, 2010). It is also considered as all the encompassing ways of experiencing and thinking about the world, including beliefs about morals, values and aesthetics” (Creswell & Plano Clark, 2018). However, Hughes (2010) stated worldview is a way for a researcher to see the world which frames research and influences the way of thinking about the research. In this study, a ‘Social Constructivist’ worldview has been chosen. In social constructivism, persons interpret their world through a philosophical perspective which is influenced by epistemological, axiological, and ontological positions of their lived reality (Boyland, 2018). Each individual interprets reality in their own way as they live in the world of personal reality. Moreover, social constructivism is a worldview where individuals try to find an understanding of their known world with their own experience (Creswell & Creswell, 2018; Denzin & Lincoln, 2018; Mertens, 2010; Schwandt, 2007). Creswell and Creswell (2018) stated social constructivism is a ‘social construction of reality’ (Johnson & Christensen, 2017) and ‘naturalistic inquiry’ (Lincoln & Guba, 2013) which hold individual’s assumptions of understanding the world in which they live and work; and develop subject meaning from their experiences towards certain objects or things. Therefore, this study deals with stakeholders’ perspectives in their real context, thus the social constructivist mechanism has been considered for conducting the research (Creswell & Creswell, 2018).

3.4 Strategies of Inquiry: A Qualitative Research Approach

The research approach will depend on the nature of the inquiry (Bell & Waters, 2018). The research questions of this study are exploratory in nature. According to Mills and Gay (2016), a qualitative research approach is required to explore the central phenomena to study the problem in some depth. However, qualitative research is the most suitable approach for exploring and developing a detailed understanding of central phenomena (Creswell, 2015; Creswell & Creswell, 2018). In this study, the central phenomena of research questions are teachers’ comprehension of ILOs; comprehension of textbooks, and teacher’s edition approach; comprehension of practiced learning opportunities in inquiry-based teaching; perception of practiced assessment methods to assess ILOs; perception of

the extent of students learning towards achieving the ILOs; challenges to practice inquiry in the science classroom; and the effects of existing constructive alignment in developing curriculum documents. Therefore, a qualitative methodology has been chosen to explore the central phenomena of this study.

The qualitative method allows the researcher to explore or investigate the quality of relationships, activities, and situations (Fraenkel et al., 2019). According to Cleland (2017), a qualitative method has the competence to address research questions regarding ‘how’ and ‘why’ that helps researchers to understand the context, phenomena, and experiences and it is very significant in educational research. Cleland (2017) added, to get the answer to W-H questions, exploration of the activity and situations is needed rather put answers into numbers to understand the phenomena, context, and experiences; this type of exploration or investigation is known as qualitative research. Moreover, the words of W-H questions help to describe and understand the value, meaning, and processes from real-life settings (Denzin & Lincoln, 2018). All the questions of the study addressed with ‘how’ and ‘what’ to explore the constructive alignment in primary science teaching practice towards inquiry and its effects on developing curriculum documents which need a qualitative research approach.

Qualitative research involves an interpretive, naturalistic approach to the world which is studying things in their natural settings and attempting to make sense of or interpret, phenomena in terms of the meaning people bring to them (Denzin & Lincoln, 2005, 2018). They also consider qualitative research as a multi-method type of research that practices an interpretive and realistic approach towards its subject matter and emphasis the meaning and processes from natural settings that include human interaction (Denzin & Lincoln, 2018). However, Bogdan and Biklen (2007) state that it is the study of an event that happened in natural settings and the individuals who were subjected to the events. Silverman (2014) suggests that “Qualitative approach is very convenient to understand people’s everyday experiences and views”. The study mainly focused on understanding participants’ experiences in a natural setting. Thus, the qualitative approach assisted the study to get a ‘deeper’ understanding of the existing status of primary science teaching practice and its effects on developing curriculum documents (Lichtman, 2014).

Finally, a qualitative research methodology was chosen as a suitable approach for the research (Creswell & Creswell, 2018; Denzin & Lincoln, 2018; Mills & Gay, 2016). This research was conducted based on seven research questions. The first research question (RQ1) is related to teachers' comprehension of the focus of ILOs in line with inquiry-based teaching-learning. The second research question (RQ2) is associated with the teachers' comprehension of the approaches of primary science textbooks and teacher's editions to facilitate inquiry-based teaching-learning. The third question (RQ3) is connected to the practiced learning opportunities for inquiry-based teaching learning in the science classroom. The fourth question (RQ4) is linked to the perception of teachers on the practiced assessment methods to achieve the ILOs. The fifth question (RQ5) involves the perception of teachers on students learning towards achieving the ILOs. The sixth question (RQ6) is related to the challenges to practice inquiry in the science classroom. The seven research question (RQ7) is concerned with the effects of existing constructive alignment on developing curriculum document.

To address RQ1, this study conducted semi-structured interviews using questionnaire with primary science teachers (who teach science), and concerned stakeholders (who are directly involved in teacher training, supervision, and monitoring) to know their comprehension of the focus of ILOs. This study also conducted lessons observation of teachers to see teachers' classroom practices; document analysis of observed lessons to know the status of the document.

To address RQ2 and RQ3, this study observed teachers' practiced lessons; conducted semi-structured interviews with teachers and concerned stakeholders; analyzed lessons-related documents; and also conducted FGD with concerned teacher's students; that explored teachers' comprehension of TB and TE approaches and the practiced opportunities in inquiry-based teaching.

To address RQ4 and RQ5, this study observed teachers' practiced lessons; analyzed lessons related documents; conducted semi-structured interviews with teachers and concerned stakeholders; FGD with concerned students, which revealed the perception of teachers about the practiced assessment methods to achieve the ILOs. The class notebooks and

summative assessment questions were also analyzed which explored the perception of teachers of the extent of students' achievement of ILOs.

To address RQ6, this study conducted a semi-structured interview with teachers and other stakeholders using a questionnaire; that explores the challenges to practice inquiry in science classrooms.

To address RQ7, this study conducted in-depth interviews with science education experts which explore the effects of existing constructive alignment on developing curriculum documents.

The followed qualitative approach guided the study to get a deeper understanding of the existing status of primary science teaching practice and its effects on developing curriculum documents

3.5 Specific Research Design: Case study

Qualitative research focuses on a diverse range of approaches including narrative, phenomenology, grounded theory, ethnography, and case study (Creswell, 2013; Creswell & Poth, 2018; Creswell & Creswell, 2018; Danzin & Lincoln, 2011, 2018; Hancock & Algozzine, 2016; Merriam & Tisdell, 2016; Stake, 2010). Among these, case study allows to development of an in-depth description and analysis of the study in-depth understanding (Creswell & Poth, 2018; Marshall & Rossman, 2016; Merriam, 2001; Merriam & Tisdell, 2016). However, case studies are good for describing and expanding the understanding of a phenomenon and are often used to study people and programs, particularly in education (Miles et al., 2014; Stake, 2010). Therefore, this study preferred case study as a specific research design to understand the phenomenon of the research questions by exploring the existing constructive alignment in primary science teaching practice towards inquiry and its effect on developing curriculum documents.

Conducting case research is considered to be appropriate when a contemporary phenomenon is to be studied in a natural setting (Benbasat et al., 1987; Miles et al., 2014; Yin, 2018). Yin (2018, p.15) also states that case study design relies on multiple data sources for evidence as the boundaries between a phenomenon and its context are not

always clear. This study aimed to explore a contemporary issue of Bangladesh in its real context, the existing constructive alignment in primary science teaching practice towards inquiry, and its effects on developing curriculum documents; here the phenomena and the context allowed the study to prefer case study approach.

Yin (2018) further elaborates that, case studies are the preferred method when the focus of the study is to answer “how” and “why” questions, and there is a contemporary focus on a set of phenomena within a real-life context when the researcher has little or no control over the events. This study has chosen case study where the focus of the study is asked through “how” research questions within its real context to get the real picture of different contexts.

Case study is a form of qualitative research methodological approach that encompasses systematically collecting enough information about particular participants or groups and the situation that allow the researcher to effectively understand the subject functions in a specific context (Berg, 2004; Berg & Lune, 2014; Lune & Berg, 2017). The focus of this study was on the individual participants and also a group of participants to get a detailed understanding of the participants in a specific context. This study has chosen case study which allows for the gathering of information from multiple sources through direct observations, interviews, protocols, tests, examinations of records, and collections of writing samples (Creswell, 2015, Creswell & Creswell, 2018). Therefore, selecting case study as a specific research design for this study is appropriate. for collecting data through direct lesson observation, interviews, and document analysis to get the real picture in a real context.

3.5.1 Specific case study approach: A multiple case study

Case study research requires a “bounded system” to define the focal point of the study within a specific time, location, and activity (Creswell, 2013; Creswell & Creswell 2018; Stake, 2010; Marriam, 2001; Miles et al., 2014; Yin, 2018, p.31). After that, a specific case study approach is needed which is guided by the overall study purpose. Yin (2009, 2012, 2014, 2018) classifies the case study approach as explanatory, exploratory, or descriptive; also distinguishes single, holistic, and multiple-case studies. Therefore, the study required

a multiple case study as it followed more than a single case, which allows the researcher to analyze within each setting and across settings (Yin, 2018).

Stake (1995, 2005, 2010) also categorizes case studies as intrinsic, instrumental, and collective; where a collective case study is used to examine more than one case which is described as a multiple case study by Yin (2018). Therefore, multiple case studies were preferred for the study, where a collective understanding of multiple issues will guide a better understanding of the research questions (Stake, 2010).

The study preferred more than one context, where each science teacher was considered as the main concern of a single case to explore the existing status of primary science teaching practice towards inquiry through teachers understanding and practice in science classrooms with supportive persons and materials, which also needed to identify the similarities and differences among the cases. Therefore, a multiple case study strategy was adopted for the study where a multiple case study allows the study to explore comparison within and among the cases (Yin, 2018).

3.5.2 Formation of the case

Within each case, a number of different sites could be visited, a range of documents could be analyzed, events or programs could be observed, and people might be interviewed (Merriam, 2001). However,¹ the unit of analysis is a critical factor in the case study as it identifies what constitutes a “case,” that is, what is a case all about. It is the “what” or “whom” being studied (Yin, 2018). In the case of multiple case design, the unit of analysis assists with the replication as well as comparison of cases (Yin, 2009, 2018). This study preferred a multiple case study approach, where primary science teachers were selected from different contexts of Bangladesh as a unit of analysis to explore the existing constructive alignment in primary science teaching practice towards inquiry and its effects on developing curriculum documents.

In this study, one primary science teacher (who teach science) from one school in a selected context was considered as a case or unit of analysis. Four teachers of different contexts: two from the urban area and two from the rural area, were selected so that the classroom practice may differ for different contexts, and the real picture of science classroom practice

in a different context would be found. Intentionally teachers will be selected using a purposive sampling strategy as the study wants to know the central phenomena by getting available needed information (Creswell, 2015; Creswell & Creswell, 2018). This research considered 4 cases, and the formation of each case is shown in the figure 3.2. Focusing on the primary science teacher, each case is formed by the following members:

- Primary science teachers (who teach science)
- Curriculum documents (Textbooks, Teacher's guide, Assessment guide)
- Primary students (grade three to grade five)
- Primary students' class notebooks
- Primary summative assessment questions
- Assistant Upazila Education Officer (AUEO)
- Upazila Resource Center Instructor (URC Instructor)
- Primary Teachers Training Institute instructor (PTI Instructor)

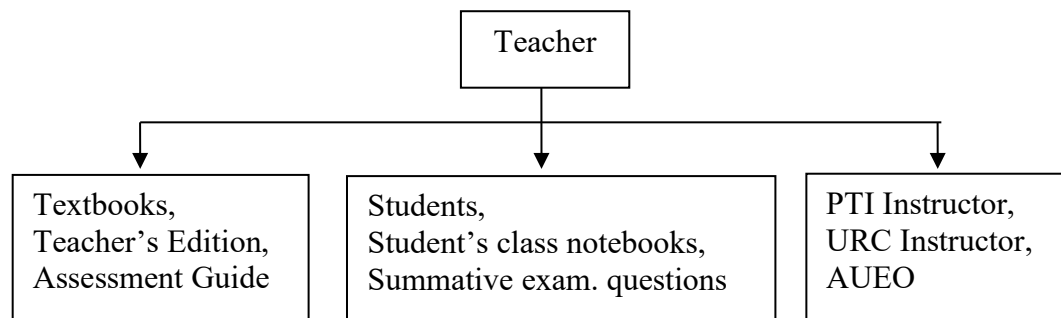


Figure 3.2: Case formation

3.6 Source of Data

A hallmark of case study research is the use of multiple data sources, enhancing data credibility and reliability (Merriam & Tisdell, 2016; Patton, 2015; Yin, 2018). In qualitative research the probable data sources are documentation, archival records, interviews, physical artifacts, direct observations, participant observation, and the various components of data sources combined together to promote a holistic understanding of the case (Baxter & Jack, 2008; Cohen et al., 2018; Yin, 2018). In this study, there were at least three types of data sources for maximum research questions, where data were compared

within and across the case studies to get maximize validity as Yin (2018) advocates the use of multiple data sources for construct validity.

The study aimed to explore the existing constructive alignment in primary science teaching practice towards inquiry and its effect on developing curriculum documents. Therefore, the main focus is to explore the existing constructive alignment among intended learning outcomes (ILOs), learning activities, and assessment of primary science teaching and practice towards inquiry. Then, explore the effects of existing alignment on developing curriculum documents. The primary science curriculum documents: science textbooks, teacher's editions, assessment guides; primary science teachers (who teach science), primary students, and primary science summative exams. Questions, and concerned stakeholders (AUEO, instructors of PTI, and URC) were selected as the source of data. Table-3.1 presents the source of data with sample and sampling.

3.6.1 Sample size

Taherdoost (2020) emphasized the careful selection of the sample and an appropriate set of questions. According to him, "A poorly selected sample can lead not only to a set of biased results but also to a high non-response rate. Ultimately, this will have implications for research analysis" (p.38). One general guideline for sample size in qualitative research is not only to study a few sites or individuals but also to collect extensive detail about each site or individual studied (Creswell & Poth, 2018). Patton (2015) stated the researcher needs awareness of the sample size to achieve the research purpose, context, and richness of the data collected; where Tuckett (2004) suggests, the 'richness' of data collected is far more important in qualitative research than the participants' number. According to Lopez and Whitehead (2013), there are no overall formal rules for determining sample size in the qualitative study; but small samples are more controllable due to the amount of potentiality-rich detailed data that can be generated from every single participant, and a common range is usually 8 to 15 participants. However, the sample size should refer to the number of groups and not to the total of participants in the study (Glenton & Carlsen, 2019). Moreover, case study research would not include more than four or five case studies in a single study (Yin, 2018). This number should provide plentiful opportunities to identify themes of the case as well as cross-case theme analysis (Creswell & Poth, 2018). The study

is exploratory in nature and preferred a small number (four cases) of samples as in exploratory and interpretive research, the researcher collects data from data sources directly related to events or individuals and the sample size should be 3-5 participants for a case study (Creswell & Poth, 2018).

Each case consists of one primary science teacher (who teaches science), one PTI instructor, one URC instructor, one AUEO, and Six-eight primary students. Moreover, primary science textbooks (TB) of grades three to grade five; teacher's editions (TE) of grades three to grade five, Assessment guides and students' class notebooks, and primary science questions (school examination) were also printed documents selected as sample materials for this study. Table-3.1 presents the source of data with sample and sampling.

Table 3.1: Source of data with sample and sampling focusing on the research questions of the study

RQ	Focus of RQ	Source of data	Sample size	Sampling
1	comprehension of the focus of ILO	TB & TE Primary teachers PTI instructor URC instructor AUEO	4×4 lessons 1×4 (rural & urban) 1×4 1×4 1×4	Purposive
2	comprehension of textbooks and teacher's guide approaches	TB & TE Primary teachers PTI instructor URC instructor AUEO Primary students	4×4 lessons 1×4 (rural & urban) 1×4 1×4 1×4 8×4	Purposive
3	Practiced learning opportunities in inquiry-based teaching learning	TB & TE Primary teachers PTI instructor, URC instructor AUEO Primary students	4×4 lessons 1×4 (rural & urban) 1×4 1×4 1×4 8×4	Purposive
4	Perception of practiced assessment methods (formative and summative) to assess ILOs	TB, TE & AG Primary science teachers PTI instructor URC instructor AUEO Primary students Formative: classroom assessment, Summative: final exam. science Q.	4×4 lessons 1×4 (rural & urban) 1×4 1×4 1×4 8×4 4×4 lessons 4	purposive
5	Perception of students learning to achieve the ILOs	Primary science teachers PTI instructor URC instructor AUEO Primary students Formative: students' class notebooks	1×4 (rural & urban) 1×4 1×4 1×4 8×4 4×4 lessons	purposive

RQ	Focus of RQ	Source of data	Sample size	Sampling
6	challenges faced by teachers to practice inquiry	Primary science teachers PTI instructor URC instructor AUEO	1×4 (rural & urban) 1×4 1×4 1×4	purposive
7	effect of existing alignments on developing curriculum documents	Science education experts	2	purposive

3.7 Instruments

Fraenkel et al. (2015) stated that instruments are one of the most intriguing parts of planning a study. Various data collection instruments are popular in educational research, while questionnaires, interviews, classroom observations, diaries, journals, etc. are used as qualitative instruments to collect data (Zohrabi, 2013). However et al. (2018) described an instrument should be simple, viable, reliable, and valid in terms of content and construct. Moreover, Wellington (2015) indicated the importance of any research in determining how instruments impact the research questions. Therefore, a set of instruments was developed to address the research question of this study. The list of instruments used in this study is presented in table 3.2 next.

Table 3.2: The relationship between research questions and instruments of the study

Instruments	Semi-structured interview schedule	In-depth interview schedule	Focus group discussion guideline	Lesson observation protocol	Documents Review Protocol
Research question					
1.How do primary science teachers comprehend the focus of intended learning outcomes in line with inquiry-based teaching?	√			√	√
2.How do primary science teachers comprehend the approaches of primary science textbooks and teacher's editions to facilitate inquiry-based teaching?	√		√	√	√
3.How learning opportunities of inquiry-based teaching are practiced in the science classroom?	√		√	√	√

4.How do primary science teachers perceive the practiced assessment methods to achieve the intended learning outcomes?	√	√	√	√
5.How do primary science teachers perceive students learning towards achieving the intended learning outcomes?	√	√	√	√
6.What challenges do primary science teachers face to practice inquiry in the science classroom?	√			
7.What is the effect of existing constructive alignments on developing curriculum documents?		√		

The main focus of RQ1 is to explore the comprehension of primary science teachers of the focus of intended learning outcomes in line with inquiry-based teaching. In this case, a semi-structured interview schedule, lesson observation schedule, and document review protocol provided information on the existing comprehension of teachers and concerned stakeholders. Understanding teachers' comprehension, lesson observation, and document review protocol was supported by knowing teachers' classroom practices, and the documents' intention. These instruments along with FGD schedules also supported the exploration of the information of RQ 2, RQ 3, RQ 4, and RQ 5 where the existing comprehension of teachers and concerned stakeholders was also explored. To understand teachers' comprehension, lesson observation, document review protocol, and FGD were supported by knowing teachers' classroom practices, and the documents' intention. To know the information of challenges about implementing inquiry in science classes, semi-structured schedules were used for RQ 6. The in-depth interview schedule was used for RQ 7 to know the expert opinion about the existing situation of primary science teaching practice in Bangladesh and its effects on developing curriculum documents. Each of the instruments is discussed briefly in the following section.

3.7.1 Semi-structured interview schedule

Interviewing is an important technique when verifying the accuracy of the observations (Fraenkel et al., 2015). Interviews are generally used in conducting qualitative research which is significant to unfold the opinions, thoughts, beliefs, values, perceptions, ideas, views, experiences, perspectives, and various other entities on specific events or issues related to research matter (Islam & Aldaihani, 2022; Showkat & Parveen, 2017; Wellington, 2015). However, interviews can be conducted in many ways: structured, semi-structured, and non-structured (DiCicco-Bloom & Crabtree, 2006; Gill et al., 2008; Islam & Aldaihani, 2022; Lopez & Whitehead, 2013; Yin, 2018). Among these, semi-structured interviews are the most widely used interviewing format for qualitative research and can occur either with an individual or in groups, which is flexible and allows to make changes during the interview, questions are mainly open-ended, and non-directed which helps participants to respond in their real context (DiCicco-Bloom & Crabtree, 2006; Lopez & Whitehead, 2013). However, semi-structured interviews have an interview guide providing a set of questions which are set to ensure the research questions or objectives are covered, and there is the freedom to ask any questions in any order, following tangents or seeking clarification of previous answers or elaboration of responses (Gill et al., 2008; Grimsholm & Poblete, 2010; Lopez & Whitehead, 2013). Moreover, the semi-structured interview design provides participants adequate time and scope to express their diverse viewpoints and provides an opportunity for the researcher to react to and follow up on emerging ideas and unfolding views (DiCicco-Bloom & Crabtree, 2006; Nohl, 2012).

Recognizing this, semi-structured interview schedule was developed for the data collection as the study aimed to understand individual participants' views with experiences through individual interviews with a semi-structured questionnaire (Appendix-1) according to the provided research phenomena (DiCicco-Bloom & Crabtree, 2006; Lopez & Whitehead, 2013). Besides teachers' interviews, the questionnaire was also used for concerned stakeholders' interviews with some changes in the third and fourth questions in each segment, where teachers were asked about their classroom practice, and concerned stakeholders were asked about teachers' classroom practice. Interviews were conducted in participants' natural settings whether it is school or their workplace, according to each

participant's availability and most of the individual interviews lasted almost two hours or more (DiCicco-Bloom & Crabtree, 2006; Lopez & Whitehead, 2013).

3.7.2 In-depth interview schedule

An in-depth interview is a qualitative research approach that comprises conducting individual interviews with a small number of respondents to reconnoiter their perspectives on a particular situation (Boyce & Neale, 2006). However, in-depth interviews are regarded as a method for qualitative data collection where data are collected narratively through a direct meeting of the researcher and the respondent (Lopez & Whitehead, 2013). Being more effective and less structured, one of the most important benefits of the in-depth interview is that it helps to uncover more detailed and in-depth information than other data collection methods like surveys (Showkat & Parveen, 2017). Moreover, in-depth interviews are generally long-duration and conducted face-to-face which allows a researcher to understand the way of response like the tone of response, facial expression, hesitation, etc. also some information along with respondents' views that were absent in written responses (Bell & Water, 2018; Showkat & Parveen, 2017). The study aimed to understand individual participants' views with experiences through individual interviews according to the provided research phenomena. Therefore, the study preferred and developed an in-depth interview schedule to explore the existing status of constructive alignment in primary science teaching practice towards inquiry and its effect on developing curriculum documents. Here, participants' in-depth perceptions of the findings of the study were the main focus; and that was conducted by a questionnaire (Appendix-2). The questionnaire was prepared to focus on the main findings of the research questions to know experts' opinions about the existing status of primary science teaching practice and its effects on developing curriculum documents. The experts were directly involved in curriculum document planning and development. The interviews were conducted according to each participant's availability and the individual interview lasted almost one hour or more (DiCicco-Bloom & Crabtree, 2006; Lopez & Whitehead, 2013).

3.7.3 Focus Group Discussion (FGD) Guideline

Focus group discussion is the collective set of attitudes, perceptions, opinions, views, values, experiences, and observations of participants, emerging from their interactions

(Cohen et al., 2018; Flores & Alonsa, 1995; Kidd & Parshall, 2000; Krueger, 1994; Litosseliti, 2007; Lopez & Whitehead, 2013; Maynard-Trucker, 2000; Murrey, 1998; Wooten & Reed II, 2000). In FGD, some specific issues, occurrence, experience, or events is taken into consideration instead of general aspects of a situation. Each member is encouraged to identify, describe, analyze, and resolve issues through supportive group interaction within an FDG (Morgan, 1997, 1998; Krueger & Casey, 2009) as they are not friendly and open-minded as an individual interview to disclose the sensitive matter (Lopez & Whitehead, 2013). Hence, the study planned focus group discussion to explore students' views about classroom teaching learning activities otherwise this may scary for them in an individual interview to uncover the real events in the classroom, as FGD allows access to the students who fear in an individual interview (Krueger & Casey, 2009). An FGD guideline was developed and used to conduct the FGD focusing on the central phenomena of the research (Appendix-3). Focus groups are in-depth discussions in which groups of between 6 and 10 individuals sharing a particular set of characteristics or experiences are brought together under the guidance of a facilitator to discuss a topic of importance to a particular study (Flores & Alonsa, 1995; Frey & Fontana, 1991; Kidd & Parshall, 2000; Murray, 1998; Suter, 2000; Walston & Lissitz, 2000). Eight students from each observed class of the concerned teacher were seated together to discuss their opinion on the given questionnaire which lasted about one hour and more. The FDG was useful for triangulating with the interviews and observations as it has been observed in the related literature that, focus groups have been used as a data collection method to fill in gaps or complement in qualitative research methods (Hargreaves, 2004; Jones et al., 2002; Knight, 2003; Newton, 2005; Riad, 2005).

3.7.4 Lesson observation protocol

Observation is a fundamental way of collecting data in qualitative research where the complete description of a participant's behavior is gathered in a specific natural setting (Adler & Adler, 1994; Angrosino & Pérez, 2000; Ary et al., 2018; Mulhall, 2003); to record aspects such as social position and function, action, and interactions that are commonly used in qualitative research (Lopez & Whitehead, 2013); where observed events are frequently used to interpret and understand participants behavior (Mulhall, 2003). Patton

(2015) proposes that observation is mandatory to realize the context in a holistic way. However, Swanborn (2010) argues that observation is a necessary element of case study research that mostly acts as a complementary purpose.

Therefore, a lesson observation protocol is needed for this study as a complementary purpose to explore the existing primary science teaching practice towards inquiry with the views getting from interviews and focus group discussions, as Angrosino and Rosenberg (2011) noted that observation focuses the whole context, both the participant's activities and the practice settings where required events take place. Observation schedules can take the form of a checklist, a diary, a chart, a time or critical incidents log, or whichever approach suits the study purpose. Spradley (1980), Williams (1994), Denscombe (2007), and Bowling (2002) all give examples of charts, grids, categories, and other methods of recording which will give the study a range of useful ideas for devising schemes. Among different methods of observational study, this study developed an observation protocol (Appendix-4) focusing on the research phenomena before the observation began. The observation protocol included capturing the classroom arrangement, study of the lesson plan, and capturing the lesson conducted. The teacher delivery, time allocation, the method of lesson introduction, teaching-learning activities, and classroom assessment methods were also noted in detail.

3.7.5 Document review protocol

Qualitative research may require a review of documents, which is often used in case studies combined with other qualitative research methods to support other collected data as a means of triangulation (Denzin, 1978; Yin, 2018). Swanborn (2010) asserted that document review is an effective method of a case study where documents are fixed and out of the researcher's influence. Bell and Waters (2018) proposed to consider a search for documents to determine the existence of different sources of information. Moreover, documents chosen as data collection sources that a researcher can easily access and have no restrictions like interviews and observations also used to balance between observation and interview (Merriam & Tisdell, 2016).

Here, the research question guided the selection of documents for this study, and depending on the research question this study conducted content analysis following a document review protocol. The documents review protocol was developed focusing on the research phenomena to collect data from the documents of the observed lessons after lessons observation. The document review protocol included the provided information in textbooks, teacher's editions and assessment guides on ILO, teaching-learning activities, and assessment methods that are followed by the participants. The students' class notebooks and summative assessment questions were also explored. These were considered supportive data to provide a holistic picture of the planned data to be collected. All these related documents were collected, and the analysis of all these documents was done simultaneously after the lesson observation in each case.

3.8 Data Collection Process

The data collection steps include setting the boundaries for the study through sampling and recruitment; collecting information from observations, interviews, documents and visual materials; as well as establishing the protocol for recording data (Creswell & Creswell, 2018). However, the data collection process is directly linked to sampling and complementary to each other where data is directly collected from identified specific samples (Islam & Aldaihani, 2022). A range of convenient data collection methods like observation, analyzing texts and documents, interviews, focus groups discussion (FGD); and audio, video, and other visual recording are typically used in qualitative research (Gill et al., 2008; Merriam & Tisdell, 2016; Patton, 2015; Silverman, 2014). However, in the qualitative approach, a case study has its own research design where data can be collected from a range of convenient methods: documents, archival records, interviews with key persons or informants, direct observation, participant observation, analyzing texts and documents, FGD, physical artifacts, and audio, video, and other visual recordings (Gill et al., 2008; Merriam & Tisdell, 2016; Patton, 2015; Silverman, 2014; Swanborn, 2010; Yin, 2018). According to Lopez and Whitehead (2013), various types of data collection methods can be used separately or in combination depending on the types of data needed for a qualitative study, and these are interviews, observation, open-ended questionnaires,

journaling where participants are directly involved; otherwise, indirect data needs hard copy or electronic form.

Therefore, the study selected observation, semi-structured interview, and focus group discussion (FGD) through ‘direct data’ collection as the focus of the study to explore existing alignment in primary science teaching learning through teacher’s classroom practice where ‘direct data’ collection refers to the thoughts, feelings, experiences, meaning of experiences, responses, actions, interactions, language and processes of individuals or groups within their social and cultural settings or contexts through observation and communication (Lopez & Whitehead, 2013). Data were also collected from document analysis as ‘indirect data’ collection method to get the effects of existing alignment on developing curriculum documents, where ‘indirect data’ was generated from documents reported by someone or something else in the first instance (Lopez & Whitehead, 2013). The main sources and procedures associated with the qualitative methods used in this study are presented in the table 3.3 (Yamagata-Lynch, 2010).

Table 3.3: Sources and procedures associated with qualitative data collection of this study

Methodology	Sources	Procedure
Lesson observations	Observed lessons of teachers	Took notes and video recordings of the observed lessons
Interviews	Teachers, Concerned stakeholders, Science education experts	Audio-recorded semi-structured interviews then transcribed the interviews
Focus Group Discussion	Concerned students	Audio-recorded focus group sessions
Document analysis	Textbooks, teacher’s Editions, Assessment Guides, Class notebooks, Summative assessment questions	Read all related materials and documents, and analyze them according to research issues

In this study, each research question followed several methodologies with several data sources where the procedures were conducted accordingly (Lopez & Whitehead, 2013).

Semi-structured interview: In semi-structured interview sessions, the study conducted face-to-face interviews with individual participants with a semi-structured questionnaire (Appendix-1) according to the provided research phenomena (DiCicco-Bloom & Crabtree,

2006; Lopez & Whitehead, 2013). Besides teachers' interviews, the questionnaire was also used for concerned stakeholders' interviews with some changes in the third and fourth questions in each segment, where teachers were asked about their classroom practice, and concerned stakeholders were asked about teachers' classroom practice. All sixteen interviews were conducted in participants' natural settings whether it is school or their workplace, according to each participant's availability (DiCicco-Bloom & Crabtree, 2006; Lopez & Whitehead, 2013). Each interview was conducted in Bangla which was convenient for the interviewee. Interviews were audio recorded using a digital Sony Handycam, and each interview lasted between two hours or more.

In-depth interview: In an in-depth interview session, interviews of science education experts were conducted with a questionnaire (Appendix-2), which was developed to focus on the main findings of the research questions to know experts' opinions about the existing status of primary science teaching practice and its effects on developing curriculum documents. The experts were directly involved in curriculum document planning and development. The interviews were conducted according to each participant's availability (DiCicco-Bloom & Crabtree, 2006; Lopez & Whitehead, 2013). Each interview was conducted in Bangla which was convenient for the interviewee. Interviews were audio recorded using a digital Sony Handycam, and each interview lasted one hour or more.

Focus Group Discussion: Eight students from each observed class of the concerned teacher were seated together to discuss their opinion on the given questionnaire (Appendix-3). The questionnaire of FGD explored the actual classroom practice through students' discussion. All four FGDs were conducted in Bangla which was convenient for the focus group participants. FGDs were audio-recorded using a digital Sony Handycam, and each lasted one hour or more.

Lesson observation: In lesson observation, this study developed an observation protocol (Appendix-4) focusing on the research phenomena before the observation began. Four lessons of each science teacher were observed, and a total of sixteen lessons of four science teachers were observed. The data from the lessons observation made was recorded through an observational checklist, field notes, and video recorded using a digital Sony Handycam. Each lesson has lasted forty to five-forty minutes.

Document review: In the document review, the provided information in textbooks, teacher's editions, and assessment guides on ILO, teaching-learning activities, and assessment methods that are followed by the participants were collected, read, and analyzed according to research issues. Students' class notebooks and summative assessment questions were also analyzed. The analysis of all these documents was done simultaneously after the lesson observation in each case.

3.9 Data Analysis Technique

Data are the raw materials collected by the researcher (Hancock & Algozzine, 2006), and data analysis is simply the process of converting the collected raw data to meaningful information. Therefore, the collected qualitative raw data have to analyze accurately which needs a suitable analysis method to get the answer of the research question. According to Patton (2014), qualitative data analysis involves interpreting interviews, observations, and documents to find substantively meaningful patterns and themes, and the analysis depends on the analytical intellect and style of the researcher (Patton, 2014). Moreover, qualitative data analysis comprises the organization of data, breaking them into controllable units, coding, synthesizing, and searching for patterns (Bogdan & Biklen, 2007). Qualitative data analysis includes the interpretation, identification, and examination of patterns and themes in textual data and determines how these themes and patterns help understand an issue or phenomenon in a deeper way for answering the research questions at hand.

The study focuses on the qualitative approach through multiple case studies. The study collected four types of data to address the research question within the qualitative approach, and these are data from documents; data from lesson observation; data from interviews (semi-structured & in-depth), and data from FGD. Therefore, the study followed thematic analysis, interviews, and FGD by following nine key aspects of textbook approaches, five key steps of inquiry-based teaching approach, and assessment approaches where each approach is considered as a theme. In thematic analysis, after collecting each type of interview data, data were transcribed, as it is a method for identifying, analyzing, and reporting patterns (themes) within data (Braun & Clark, 2006). After the transcription, the data were summarized and then coded the data according to predetermined themes as Creswell (2015) stated that thematic analysis developed themes from data consisting of

answering the major research questions and forming an in-depth understanding of the central phenomena. The collected data from documents and lessons observation is directly coded by the developed scales according to the predetermine themes to corroborated with the analyzed interview data. Table 3.4 shows the relationship between research questions, instruments, and data analysis methods.

Table 3.4: The relationship between instruments and analysis methods of the study

RQ	Focus of RQ	instruments	Analysis methods
1	comprehension of ILO focus	Document review protocol lesson observation schedule semi-structured interview schedule	Code categories Identify themes and relevant extracts from interview transcription
2	comprehension of textbooks and teacher' guide approach	Document review protocol lesson observation schedule semi-structured interview schedule FDG	Code categories Identify themes and relevant extracts from interview transcription
3	Practiced learning opportunities in inquiry-based teaching learning	Document review protocol lesson observation schedule semi-structured interview schedule FDG	Code categories Identify themes and relevant extracts from interview transcription
4	Perception of practiced assessment methods (formative and summative) to assess ILOs	Document review protocol lesson observation schedule semi-structured interview FDG	Code categories Identify themes and relevant extracts from interview transcription
5	perception of students learning to achieve the ILOs	Document review protocol lesson observation schedule semi-structured interview schedule FDG	Code categories Identify themes and relevant extracts from interview transcription
6	challenges faced by teachers to practice inquiry	semi-structured interview schedule	Identify themes and relevant extract from interview transcription
7	effect of existing alignments on developing curriculum documents	In-depth interview schedule	Identify themes and relevant extract from interview transcription

3.9.1 Content analysis from documents review protocol

Berg and Lune (2017), draw on several sources to define content analysis as “a careful, detailed, systematic examination and interpretation of a particular body of material in an effort to identify patterns, themes, biases, and meanings” (p.182). Similarly, Krippendorff (2019) states that “content analysis is a research technique for making replicable and valid

inferences from text (or other meaningful matter) to the contexts of their use” (p. 24). Information researchers Zhang and Wildemuth (2009) take the latent aspect one step further in their discussion of qualitative content analysis with the assertion that the aim is “to understand social reality in a subjective but scientific manner” (p. 308). The study desired to explore the existing constructive alignment of primary science teaching practice. One of the main data sources of this study was documents. Qualitative content analysis probes the text for repeating words or themes of a document (Patton, 2002). Therefore, the data from the document’s content of this study needed a qualitative content analysis technique. a scale was developed and used for data collection and from documents directly and then analyzed by coding. Table 3.5 addressed the scale followed for collecting data from documents. Vagias’s (2006) Likert-scale technique has been used to develop scales.

Table 3.5: Scale for the level of addressed information in curriculum documents

Indicators	Level of addressed
Provides information with examples completely	Extremely Addressed
Provides information with partial examples	Moderately addressed
Provides partial information with partial examples	Somewhat addressed
Did not provide	Not addressed

3.9.2 Thematic analysis of the interviews

In thematic analysis, after collecting each type of interview data, data were transcribed, as it is a method for identifying, analyzing, and reporting patterns (themes) within data (Braun & Clark, 2006). After the transcription, the data were summarized and then coded the data according to predetermined themes as Creswell (2015) stated that thematic analysis developed themes from data consisting of answering the major research questions and forming an in-depth understanding of the central phenomena. Here also a developed scales were used to analyze the interview data and table 3.6. Vagias’s (2006) Likert-scale technique has been used to develop scales.

Table 3.6: Scale for the level of stakeholders’ comprehension

Aspects	Indicators	Level of comprehension
Meaning or Importance	Gave explanation with example completely	Extremely comprehend
	Gave explanation with partial example	Moderately comprehend
	Gave partial explanation with partial example	Somewhat comprehend
	Did not know	Not comprehend

Aspects	Indicators	Level of comprehension
Information provided in TB & TE	Knows about both TB and TE completely	Extremely comprehend
	Knows about TB completely and TE partially	Moderately comprehend
	Knows about only TB	Somewhat comprehend
	Did not know	Not comprehend
Classroom practice	Gave explanation with example completely	Extremely comprehend
	Gave explanation with partial example	Moderately comprehend
	Gave partial explanation with partial example	Somewhat comprehend
	Did not know	Not comprehend

3.9.3 Analysis of data from lessons observation schedule

Lesson observation schedule is developed focusing the predetermined approaches of curriculum documents, inquiry and assessment methods. Collected data was directly coded by a developed scales (Table 3.7) and then corroborated with the analyzed interview data. Vagias's (2006) Likert-scale technique has been used to develop scales.

Table 3.7: Scale for the level of teachers' lesson practice

Indicators	Level of practice
Follow the instruction given in the TB & TE, completely	Extremely Practiced
Follow the instruction given in the TB & TE, partially	Moderately practiced
Follow the instruction given in the TB or TE only	Somewhat practiced
Did not practice	Not practiced

3.10 Methodology Matrix of the Study

A methodology matrix of this study is presented here with sources of data, sample and sampling, instruments, and analysis focusing on the research questions.

Table 3.8: Methodology matrix of the study

RQ	Focus of RQ	Source of data	Sample size	Sampling	Instruments	Analysis
1	comprehension of the focus of ILO	TB & TE	4×4 lessons	Purposive	Document review protocol lesson observation schedule semi-structured interview schedule	Content analysis Thematic analysis
		Pri. teachers	1×4			
		PTI instructor	1×4			
		URC	1×4			
		instructor	1×4			
2	comprehension of textbooks and teacher's guide approaches	AUEO		Purposive	Document review protocol lesson observation schedule semi-structured interview schedule FDG guideline	Content analysis Thematic analysis
		TB & TE	4×4 lessons			
		Pri. teachers	1×4			
		PTI instructor	1×4			
		URC	1×4			
		instructor	1×4			
		AUEO				
		Pri. students	8×4			

RQ	Focus of RQ	Source of data	Sample size	Sampling	Instruments	Analysis
3	Practiced learning opportunities in inquiry-based teaching learning	TB & TE	4×4 lessons	Purposive	Document review protocol lesson observation schedule semi-structured interview schedule FDG guideline	Content analysis Thematic analysis
		Pri. teachers	1×4			
		PTI instructor	1×4			
		URC	1×4			
		instructor	1×4			
4	Perception of practiced assessment methods (formative and summative) to assess ILOs	AUEO		purposive	Document review protocol lesson observation schedule semi-structured interview FDG guideline	Content analysis Thematic analysis
		Pri. students	8×4			
		TB, TE & AG	4×4 lessons			
		Pri. teachers	1×4			
		PTI instructor	1×4			
5	perception of students learning to achieve the ILOs	URC	1×4	purposive	Document review protocol lesson observation schedule semi-structured interview schedule FDG guideline	Content analysis Thematic analysis
		instructor	1×4			
		AUEO	8×4			
		Pri. students	4×4 lessons			
		students' class notebooks				
6	challenges faced by teachers to practice inquiry	Pri. teachers	1×4	purposive	semi-structured interview schedule	Thematic analysis
		PTI instructor	1×4			
		URC	1×4			
		instructor	1×4			
		AUEO				
7	effect of existing alignments on developing curriculum documents	Science education experts	2	purposive	In-depth interview schedule	Thematic analysis

3.11 Trustworthiness

Trustworthiness refers to the quality, authenticity, and truthfulness of the findings of qualitative research. According to Pilot and Beck (2014), the trustworthiness or rigor of a study refers to the degree of confidence in data, interpretation, and methods used to ensure the quality of a study. In each study, researchers should establish the protocols and procedures necessary for a study to be considered worthy of consideration by readers (Amankwaa, 2016). Trustworthiness is one-way researchers can persuade themselves and

readers that their research findings are worthy of attention (Lincoln & Guba, 1985). The most accepted and highly cited system of quality criteria for qualitative research is that developed by Guba, Lincoln, and colleagues (Guba, 1981; Lincoln, 1995; Lincoln & Guba, 1985; Lincoln et al., 2011). These criteria include credibility, dependability, confirmability, and transferability; they later added authenticity (Guba & Lincoln, 1994). Yin (2018) suggests four patterns that have been commonly used to establish the quality of any empirical research including qualitative case study research, these are trustworthiness, credibility, confirmability, and data dependability. The terms trustworthiness and authenticity were also used in an attempt to define validity and reliability in qualitative research (Emden & Sanselowski, 1998). In this study, trustworthiness is preferred as a basis of believability or reliability, validity, and credibility of the research (Harrison et al., 2001; Yin, 2018). Each of these is described next.

Validity and reliability: Validity embodies honesty, depth, richness, and trustworthiness in the collection and presentation of results, what participant report should be considered fact and remain undisputed and sincerely reported (Silverman, 2001). Based on the research questions, the study had appropriately chosen the data collecting methods of semi-structured interviews, lessons observation, documents analysis, FGD, and in-depth interviews to understand teachers' and stakeholders' comprehension, teachers' classroom practice. The study ensured that validity was viewed from the viewpoint of achieving accuracy in the findings from the perspective of the participants and the researcher. The accuracy of the findings was increased by the use of detailed, in-depth descriptions of the data to convey the findings (Creswell & Creswell, 2018).

Reliability is an examination of the stability or consistency in responses (Creswell & Creswell, 2018). In order to maintain reliability in the study, the relationship between the researcher and the participants was clearly articulated, the interview was made comprehensive and rigorously detailed, and the lesson observation and document records were done through written descriptions as well as video recordings. The interview questions that were developed were trialed before the actual study took place. The key information about the participants and the study information had been detailed as well (Mills & Gay, 2019).

Credibility: Credibility in qualitative research means confidence in the data. It is the most important criterion that addresses the confidence in the ‘truth’ of the findings like respondents’ views and the researcher’s interpretation and representation (Lincoln & Guba, 1985; Pilot & Beck, 2014; Tobin & Begley, 2004). One method to promote credibility is through the various process of triangulation (Lincoln & Guba, 1985, Stahl & King, 2020). The study collected more than a single type of data to establish findings, and these are data from interviews, documents, lessons observation, and from FGD which refers to the data collection triangulation (Lincoln & Guba, 1985; Stahl & King, 2020). Furthermore, the study also conducted research in more than one context to study the intended focus which refers to environmental triangulation (Lincoln & Guba, 1985; Stahl & King, 2020). Credibility can also be operationalized through the process of ‘member checking’/’peer checking’ to test the findings and interpretations with the participants (Lincoln & Guba, 1985, 1985; Stahl & King, 2020). The developed scales for data collection and data analysis and the analysis of the documents were checked by the expert members to give their feedback regarding the accuracy of the data. All these enhanced the study’s credibility.

Transferability: A second factor for trustworthiness offered by Lincoln and Guba (1985) is applicability in qualitative research which refers to fittingness or transferability, showing that the findings have applicability in other contexts. It is defined as the degree to which the results of the research can apply or transfer beyond the bounds of the research (Polit & Beck, 2014; Stahl & King, 2020). The transfer is only possible when the researcher provides a ‘thick description’ with a rich enough portrayal of circumstances for the application to others’ situations, and those who seek to transfer the findings to their own context can judge transferability (Amankwaa, 2016; Lincoln & Guba, 1985; Nowell, Norris, White & Moules, 2017; Stahl & King, 2020). This study has given a ‘thick description’ of the research, which helps others to judge transferability for further use in their own sites. This study includes the number of participating organizations in the research, constraints in the type of individuals who provide information, the number and length of the data collection sessions, and the period of time over which the data was accumulated. All these addressed the transferability of this study.

Dependability: The third perspective on trustworthiness offered by Lincoln and Guba (1985) is dependability or trust in trustworthy, showing that the findings are consistent and could be repeated. Dependability is defined as the steadiness of the data when the research is carried out in similar conditions (Polit & Beck, 2014; Tobin & Begley, 2004). One way that a research study may demonstrate dependability is for its process to be audited (Koch, 1994; Lincoln & Guba, 1985). An inquiry audit means data and relevant supporting documents are scrutinized by an external reviewer. In this study, data were scrutinized by the external reviewer that addressed the dependability of the study by inquiry audit.

Confirmability: Confirmability in qualitative research means the degree to which other people could confirm or corroborate the outcomes. It is the fourth perspective on trustworthiness (Lincoln & Guba, 1985), a degree of neutrality or the extent to which the findings of a study are shaped by the respondents and not the researcher's bias, motivation, or interest (Polit & Beck, 2012; Tobin & Begley, 2004). Guba and Lincoln (1989) also stated confirmability is established when credibility, transferability, and dependability are all achieved. This study demonstrated confirmability by presenting the findings with direct quotes from the participants' responses, as confirmability is concerned with establishing that the researcher's interpretations and findings are clearly derived from the data, requiring the researcher to demonstrate how conclusions and interpretations have been reached (Tobin & Begley, 2004). Koch (1994) recommended researchers include markers such as the reasons for theoretical, methodological, and analytical choices throughout the entire study so that others can understand how and why decisions were made, which refers to an audit trail for confirmability. This study provided the rationale for theoretical, methodological, and analytical choices of the study that addressed the confirmability of the study.

However, triangulation was accomplished to narrow the chances of invalid data being used as evidence in the subsequent findings of the research. Creswell (2005, 2014) defines triangulation as the process of corroborating evidence from different types of data from different individuals and different methods of data collection in qualitative research. The study analyzed data from different data sources: document analysis, lessons observations, and semi-structured interviews, FGD; which ensured the triangulation of the study as well

as the accuracy, confirmability, reliability, and validity of this research. The process was used when ensuring that each stakeholder was comfortable with their responses, and is similar to the process known as member checking, which strengthens the validity of findings (Creswell, 2005, 2014).

3.12 Ethical Issues

The importance of ethical considerations was emphasized by Wellington (2015), ‘that the main criterion for educational research is that it should be ethical. In qualitative research, it is a major responsibility of the researcher to protect participants from harm (Isreal & Hay, 2006; Merriam & Tisdell, 2017). Therefore, it is important to minimize the major ethical principles: the risk of harm by ensuring, inter alia, informed consent, protection of anonymity and confidentiality, and nonuse of any deceptive practices, including options for participants to withdraw from the research at any time (Fisher & Anushko, 2008; Homan, 1991; Isreal & Hay, 2006).

The study took official written permission from the Directorate of Primary Education (DPE), Ministry of Education, Bangladesh to access any primary school in Bangladesh (Appendix 5). Then, communicated with District Primary Education Officer (DPEO) over the phone; DPEO confirmed the Assistant Upazila Education Officer (AUEO) according to my research desire; finally, AUEO arranged the primary school, and communicate with the primary school head teacher; head teacher selected the primary science teacher as the research desire. Before going to the school, I communicated with all of them to ensure my research desire over the phone and also communicated with the concerned Upazila Resource Center (URC) instructor and Primary Teacher’s Training Institute (PTI) instructor over the phone. The study followed up with an explanatory statement for participants in which the purpose of the research was stated; why they were chosen as participants; their right to withdraw from their participation, confidentiality; how the data would store and use (Appendix 6) (Fisher & Anushko, 2008; Homan, 1991; Isreal & Hay, 2006; Principles of research ethics). A consent form has been provided to the participants from which, they were clearly informed that their participation was voluntary and they could stop participation at any time (Christians, 2005; Denzin & Lincoln, 2018; Shaw, Boynton & Greenhalgh, 2005) (Appendix 7).

The interview was scheduled with participants' verbal consent so that they could give their views with time and think freely (Bogdan & Biklen, 2007), and also used the code name of the participants to keep them harmless (Christians, 2005). They had to ensure that their real personal information will remain hidden which could be a threat to participants' anonymity and confidentiality (Fisher & Anushko, 2008; Homan, 1991; Isreal & Hay, 2006). This process requires a sufficient level of trust based on a high level of participant disclosure (Creswell, 2015; Creswell & Creswell, 2018).

Before starting the interview with each participant, I introduced myself and explain the research objectives in short. Participants were found interested, cooperative, and spontaneous to express their views. They shared different challenges faced by them during teaching-learning activities and other issues related to the primary education system. Their cooperation helped me to get closer to them, understand participants' perceptions, and make good relationships with them, as a result, I got the opportunity to review my interview session wherever needed through the online Zoom platform, messenger, etc. during this covid-19 emergency situation. I collected the consent form with the signature, address, and also contact number of each participant so that I can contact them in any emergency during the research, which also helped me to communicate with them during the covid-19 period. The raw data is confidentially stored to me only.

3.13 Methodological Issues

3.13.1 Issue of getting data from real context

The study aimed to explore the existing constructive alignment in primary science teaching practice and its effect on developing curriculum documents. The study had to collect observation and interview data from four primary science teachers' classroom practices, concerned students, concerned Instructors of PTI and URC, and concerned AUEO of four districts of Bangladesh. Therefore, I had to go to four primary schools, the DPEO office, Primary Teachers Training Institute (PTI), and Upazila Resource Center (URC) through proper channels with getting permission from the Directorate of Primary Education (DPE). Therefore, I was compelled to inform the participants before going there. Teachers got the opportunity to take extra preparation rather than his/her usual practice, which was claimed by all the concerned stakeholders who were already got such experiences; they are the

academic supervisor and trainers who are employed to supervise, training, and monitoring of primary teachers. This extra preparation for science teachers' classroom practice could be interrupted the study data to get real practice data.

3.13.2 Language and transcription issue

Our mother tongue is “Bangla” in Bangladesh and it is our official language. The study is conducted in English. The study served all the questionnaires translated into Bangla (Appendix 1-3) to ensure a better understanding of the participants. However, I had to explain all the keywords during the interview session. The study preferred semi-structured interviews, in-depth interviews, and FGDs; and it was challenging to keep the participants in the focus of the questionnaire track and to find out their interview statements focusing on the questionnaire. I had to translate all these responses into English before analysis.

3.14 Chapter Summary

This chapter has included the methodological details of this study. In the beginning, it readdressed the research questions, conceptual framework, Philosophical worldview, and strategy of inquiry were provided in detail. In the following section, the research process was defined including specific research design, sources of data, instruments, data collection process, and data analysis technique. In the end part of the chapter, here discussed methodology matrix, trustworthiness, ethical issues, and methodological challenges of the study were also discussed.

The next chapter addresses the study's findings in relation to the existing status of constructive alignment in primary science teaching practice towards inquiry and its effects on developing curriculum document.

Chapter Four: Results

This chapter presents the results of qualitative data analysis based on collected data from documents analysis, lesson observations, semi-structured interviews, in-depth interviews and FGDs. The emerging data from document analysis and lesson observations have been interpreted. Interviews and FGDs were transcribed by ensuring participants' actual words, and their direct explanations are presented as quotes. Case wise results are presented where case-A, case-B, case-C, and case-D was designed in relation to the research questions to explore the constructive alignment in intended learning outcomes, teaching-learning activities and assessments, and its effect on developing curriculum document. Tables 4.1, 4.2, and 4.3 provide scales for the level of stakeholders' comprehension, provided information in documents, and teacher's classroom practice sequentially. Vagias's (2006) Likert-scale technique has been used to develop scales. The tables are represented here.

Table 4.1: Scale for the level of stakeholders' comprehension

Aspects	Indicators	Level of comprehension
Meaning or Importance	Gave explanation with example completely	Extremely comprehend
	Gave explanation with partial example	Moderately comprehend
	Gave partial explanation with partial example	Somewhat comprehend
	Did not know	Not comprehend
Information provided in TB & TE	Knows about both TB and TE completely	Extremely comprehend
	Knows about TB completely and TE partially	Moderately comprehend
	Knows about only TB	Somewhat comprehend
	Did not know	Not comprehend
Classroom practice	Gave explanation with example completely	Extremely comprehend
	Gave explanation with partial example	Moderately comprehend
	Gave partial explanation with partial example	Somewhat comprehend
	Did not know	Not comprehend

Table 4.2: Scale for the level of addressed information in curriculum documents

Indicators	Level of provided information
Provides information with examples completely	Extremely Addressed
Provides information with partial examples	Moderately addressed
Provides partial information with partial examples	Somewhat addressed
Did not provide	Not addressed

Table 4.3: Scale for the level of teachers' lesson practice

Indicators	Level of practice
Follow the instruction given in the TB & TE, completely	Extremely Practiced
Follow the instruction given in the TB & TE, partially	Moderately practiced
Follow the instruction given in the TB or TE only	Somewhat practiced
Did not practice	Not practiced

The following analysis of each case includes the Information provided in curriculum documents (TB, TE & AG), teacher's classroom practice, and stakeholders' comprehension, about the focus of intended learning outcomes (ILOs), about the approaches of textbooks (TB) & teacher's edition (TE), about the practiced learning opportunities for inquiry-based teaching learning in the science classroom; teacher's perception about the practiced assessment methods to achieve the ILOs, about students learning towards achieving the ILOs; about the challenges to implement those approaches; and the effects of existing alignment on developing curriculum document.

Case study A

In case A, teacher1 was from an urban area. Other stakeholders were the PTI instructor, URC instructor, and AUEO, who are engaged in teacher training, supervision, and monitoring. Some students of teacher1 have also participated in FGD.

The following section explores stakeholders' comprehension of intended learning outcomes through semi-structured interviews. Here, stakeholders' responses explore their level of comprehension about the focus of ILOs.

4.1 Stakeholders' Comprehension about the Focus of ILOs

This section presents teacher's lesson observations, the provided information in TB and TE, and stakeholders' views about the focus of ILOs.

Teacher's classroom practice

It has been explored from the four observed lessons that, teacher1 focused only knowledge level of ILO the other two focuses: skill and attitude are absent. Table 4.4 presents T1's lessons practice of the focus of ILO.

Table 4.4: Teacher 1's classroom practice about the focus of ILOs in Grade-3, Chapter-Soil

No of ILO	ILO in TE	Lessons in TE	Lesson title	Lessons taken by teacher1	Teacher's focus on ILO
4.1.2	will be identify soil on the basis of its structure	Lesson-1	element of soil	Lesson-1	Focused only knowledge
4.1.1	will be able to tell the types of soil	Lesson-2 &3	different types of soil		

Stakeholders' views

Learning outcomes are, what students are able to demonstrate in terms of knowledge, skills and attitudes after completion of a course (Adam, 2006; Biggs, 2003; Dillon, 2005; Battersby, 1999). In the interview, stakeholders were asked about the meaning of ILO, about the importance of ILO focus, and about the way of identifying ILO focus to know their comprehension of ILOs. In response to the question 'What is the intended learning outcome-explain with an example.' T1 replied,

What the students will learn from reading a paragraph is ILO, the knowledge which they have achieved from the content is LO. For example, in the soil chapter, they will know about soil, like what is soil, soil types and identify the soil. Here, the LO is-will be able to tell what is soil, its types and identify the soil.

In the statement, T1 explained ILO as students' achievement of knowing and identifying something from content. However, the other two important focuses of ILO are skill and attitude, are totally absent in the explanation; which reveals teacher's somewhat comprehension of ILOs.

Moreover, according to Battersby (1999), ILO guides instructors to focus on a broad synthesis of abilities of people that combine knowledge, skills, and values into a whole that reflects how people really use their achieved knowledge. In the interview, when asked 'What are the importance of ILO focus-explain with example?', the URCInstructor1 stated,

The focus of LO is very important and that is knowledge, understand and application, if the students do not achieve LO then they could not match with the next level. Curriculum, teaching learning, and assessment all are LO based. TE mentioned LO for all the lessons and teachers teach the same thing following LO. For example, in the soil chapter, if the LO is not focused then the teacher will learn differently and time management is also a big concern in that case.

In the statement, URCI1 stated the importance of ILO focus for guiding the teachers, and the ILO focus is knowledge, understand and application, which reveals the dearth of information of URCI1. Hence, URCI1 has somewhat comprehension of the importance of ILO focus.

Furthermore, learning outcomes are statements of what a student is expected to know or be able to do as a result of a learning activity. Outcomes are usually expressed as knowledge, skills and attitudes (Adams, 2006). In response to the question ‘How did you identify the focus of ILO-explain with example?’, the AUEO1 revealed that,

For example, what is soil? the definition is in the TB and students can answer through memorization, this is knowledge level. The difference between soil and sand, students will think and say, this is understand level and finally if they apply their knowledge in real life that means crops grow well in loamy soil and they apply it during plant seedling project-then it is application level LO. These are the three focuses of ILO.

In the statement of AUEO1, the common terms as ILO focus are knowledge, understand and application, which reveals somewhat comprehension of AUEO1 about ILO focus. Hence, AUEO1 has somewhat comprehension of the identification of ILO focus.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher’s editions (TE), it is found that TB did not mention ILOs; and TE mentioned ILOs but did not address ILO focus.

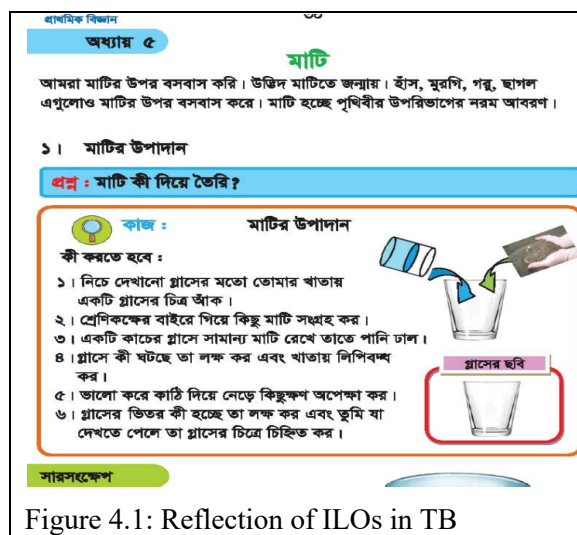


Figure 4.1: Reflection of ILOs in TB

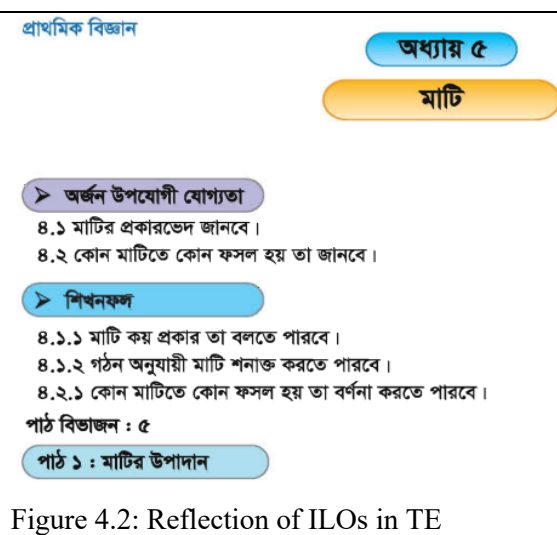


Figure 4.2: Reflection of ILOs in TE

A summary finding of stakeholders’ level of comprehension about the focus of intended learning outcomes is presented in the table 4.5.

Table 4.5: Summary of findings on stakeholders' comprehension about the focus of ILOs

Stakeholders	Stakeholders' view about focus of ILOs			Overall comprehension of ILOs	Chapter Lesson & no. of ILO in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Meaning of ILO	Importance of ILO focus	Way of identify ILO focus				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lesson: 1 ILO: 4.1.2	Not practiced	Not addressed	Somewhat addressed
					Chapter:5 Lessons: 2&3 ILO: 4.1.1	lessons-1: somewhat practiced	Not addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lessons: 4&5 ILO: 4.2.1	lessons-2: somewhat practiced	Not addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1 ILO: 5.1.1	lessons-3: somewhat practiced	Not addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Not addressed	Somewhat addressed

The findings reveal that, teacher and concerned stakeholders have somewhat comprehension of the focus of ILOs. Teacher somewhat practiced the focus of ILOs in the science classroom. ILOs did not address in textbooks (TB), and somewhat addressed in teacher's edition (TE).

➤ Overall remarks

Teacher1's comprehension about the focus of ILOs was reflected in T1's lessons practice. Concerned stakeholders' somewhat comprehension about the focus of ILOs, may also be reflected in teacher's comprehension as they are engaged in teacher training, supervision, and monitoring. The somewhat provided information in curriculum documents may also be reflected in concerned stakeholders' comprehension T1's comprehension and lessons practice.

4.2 Stakeholders' Comprehension of the Approaches of Primary Science Textbooks (TB) and Teacher's Edition (TE)

In this research, nine key aspects have been identified to explore stakeholders' comprehension of the approaches of textbooks (TB) and teacher's editions (TE) and these are-1. Starting lesson with a key question 2. Exploring students' prior knowledge 3. Real-life orientation of science concept 4. Science process skills 5. Activity-based class 6.

Collaborative learning 7. Illustrations (pictures and photographs) 8. Scope of scientific inquiry 9. Lesson summary.

The following section presents the results of the teacher and concerned stakeholders' views, teacher's lesson observations, documents analysis, and Focus group discussion (FGD) of students about the approaches of TB and TE. Here, stakeholders have been asked for a semi-structured interview, four lessons of the teacher have been observed; and TB and TE have been used as documents. Documents analysis refers to what is in the document; lesson observations refer to the teacher's classroom practice that what the teacher actually does in the classroom during conducting lessons, and interview and FGD refer to stakeholders' actual words of understanding.

4.2.1 Starting lesson with a key question

Starting lesson by posing question make the learning interesting and allow students to explore, explain, extend, and evaluate their progress (NRC, 2000). The National Research Council (NRC, 1996) also recommends exploring authentic questions from students' experiences to be key to the success of inquiry science teaching. According to Minstrell (2000), scientific inquiry arises from curiosity, which naturally leads to questioning.

Teacher's classroom practice

It has been explored from the observed lessons that, teacher1 started two classes with lesson title related songs, one with rhymes and one with prior knowledge exploring question. After that the teacher started teaching learning activities and did not focus on key question. Table 4.6 presents a lesson practiced by T1, where T1 started class with a song and did not focus key question in teaching-learning activities.

Table 4.6: Teacher 1's classroom practice about starting lesson with a key question in Grade-3, Chapter-Soil

ILO	Lessons in TE	Lesson title	No. of lessons taken by the teacher	Lesson objectives given in TE for key question	Key question given in TE and TB	Teacher's focus on key question	Way of starting lesson by the teacher
4.1.2	1	Components of soil	Lesson-1	*What is soil? *Which elements make soil?	What is soil made of?	did not mention	Lesson title related song
4.1.1	2 & 3	Different types of soil		*What is the difference among three types of soil?	what are the differences		

ILO	Lessons in TE	Lesson title	No. of lessons taken by the teacher	Lesson objectives given in TE for key question	Key question given in TE and TB	Teacher's focus on key question	Way of starting lesson by the teacher
				*How could we compare them?	between the three types of soil?		

Stakeholders' views

Several literatures have argued that starting a lesson with key question is helpful for students' effective learning. Such a way of starting a lesson, can easily engage students in teaching-learning activities (Cheesman, 2005). Moreover, National Research Council (2000) stated that, starting lesson by posing question make the learning interesting one and allow students to explore, explain, extend, and evaluate their progress. To know stakeholders' view, they were asked about the importance of key question to start a lesson. Among them PTI instructor1 narrated that,

It is very important to know students' previous knowledge in the starting of a lesson. So prior knowledge exploring question is very important for the teacher to know students' condition.

The statement expresses PTII1's comprehension and that was, asking question in the starting of a lesson is for exploring students' prior knowledge. PTII1 mentioned key question as prior knowledge exploring question. Hence, PTII1 do not comprehend the TB and TE approach of starting lesson with a key question.

In addition, it is stated in the beginning of primary science textbooks as a major feature that, key question is highlighted as the core points of teaching learning in each lesson (NCTB, 2020). In response to the question 'what are the focuses of key question to start a lesson in textbooks and teacher's edition?', among the stakeholders AUEO1 opined that,

Our work dimension is as much that we do not get chance to go through the science TB or TE that way or deeply. Where student cannot read Bangla and English, what will we do with science, so we do emphasis in reading Bangla and English first then science.

The statement reflects AUEO1's unawareness about TB and TE as AUEO1 did not notice the provided key question in TB and TE that way. Consequently, AUEO1 did not comprehend the approach of key question in curriculum documents.

Furthermore, Protheroe (2007) stated that lesson starts by posing question involves students to arouse their curiosity and engage them in further investigation. Stakeholders were asked about classroom practice of key question to start a lesson. The teacher had the reply that,

Today I sang a content related song to start the class; another event will do for another lesson so that the students can understand they will be questioned on that... Among these, starting lesson with prior knowledge exploring question help me to know students' condition and guide me to conduct the class.

The statement explores that, teacher1 focuses prior knowledge exploring question in the starting of a lesson and that reveals, T1 did not comprehend the practice of key question in science classroom.

Students' response in FGD

Students' of FGD were asked about the way of starting lesson. Their common response was, usually their class starts with reading text from books. One of them stated that,

Teacher instructs us to read the textbook, one of us read and we all follow; sometimes teacher start the lesson with singing song or rhymes or some questions; we answer, if we can't then sir reply us.

In the statement of the student, it asserts that the teacher did not focus on key question to conduct lesson.

Information provided in TB and TE

Figure 4.3: Reflection of Key question in TB

Figure 4.4: Reflection of key question in TE

At the beginning of primary science textbooks of Bangladesh, it is clearly stated as “Major Feature of the Revised Primary Science Textbooks” that the key questions highlighted as the core points of teaching learning in each lesson (NCTB, 2020).

Analyzing the primary science textbooks (TB) and teacher’s editions (TE), it is found that there is a focus on key question to start a lesson. Key question is highlighted in the starting of teaching learning activities of each lesson in TB (Figure 4.3). Whereas, it is placed after prior knowledge exploring question and lesson objectives related questions of teaching learning activities in TE (Figure 4.4). Therefore, this approach is extremely addressed in TB and TE. Table 4.7 summarized the findings of documents analysis, lesson observations and stakeholders’ comprehension to start lesson with a key question.

Table 4.7: Summary of findings on starting lesson with a key question

Stakeholders	Stakeholders’ comprehension about starting lesson with a key question			Overall comprehension	Chapter & lessons in Grade three	Teacher’s lesson practice	Information provided (Based on literature review)	
	Importance of key question	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Chapter:5 Lesson: 1	lessons-1: did not practice	Extremely addressed	Extremely addressed
					Chapter:5 Lessons: 2&3		Extremely addressed	Extremely addressed
PTI instructor	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Chapter:5 Lessons: 4&5	lessons-2: did not practice	Extremely addressed	Extremely addressed
URC instructor	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Chapter: 6 Lesson: 1	lessons-3: did not practice	Extremely addressed	Extremely addressed
AUEO	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Chapter: 6 Lesson: 2	lessons-4: did not practice	Extremely addressed	Extremely addressed

The findings reveal that, teacher and concerned stakeholders did not comprehend about starting lesson with a key question. Teacher did not focus key question in the science classroom. Key question extremely addressed in textbooks (TB) and in teacher’s edition (TE).

➤ Overall remarks

Teacher1’s comprehension about starting lesson with a key was reflected in lessons practice as T1 did not focus key question in the science classroom. However, concerned stakeholders’ comprehension may also be reflected in teacher’s comprehension and

classroom practices. Though curriculum documents extremely addressed key question but it was not reflected in T1 and concerned stakeholders' comprehension.

4.2.2 Exploring students' prior knowledge

Teacher's classroom practice

It has been explored from the observed four lessons that, the teacher had explored students' prior knowledge for the first lesson; and explored review of the previous lesson without exploring prior knowledge for the rest of the three lessons by his own way. Therefore, students' prior knowledge was explored somewhat. T1's classroom practice of prior knowledge exploration of a lesson is shown in table 4.8, that reveal T1 has taken three lessons in one class and has explored students' prior knowledge focusing only lesson-1 of TE. Therefore, teacher's lessons practice has been considered as somewhat practiced regarding students' prior knowledge exploration.

Table 4.8: Teacher 1's classroom practice about exploring students' prior knowledge in Grade-3, Chapter-Soil

ILO	Lesson in TE	Lesson title	No. of taken class by the teacher	Prior knowledge exploring Q. given in TB	Prior knowledge exploring Q. given in TE	Question from previous lesson given in TE	Exploring prior knowledge by the teacher
4.1.2	1	Components of soil	Lesson-1	-	*Where do we live? *where do plants grow?	-	*Where do we walk? *where does cow, duck, hen walk?
4.1.1	2 & 3	Different types of soil		Text on soil types	-	what are the components of soil?	*where do we live?

Stakeholders' views

Exploring students' prior knowledge can guide teachers to design appropriate teaching strategies and also helps teachers to know student's alternative conceptions or misconceptions (Posner,1982). Stakeholders were interviewed to know their views about exploring students' prior knowledge. In response to the question 'What is the importance of exploring students' prior knowledge in the relevant topic?', AUEO1 expressed that,

It is important to explore students' prior knowledge. The previous lesson is sustained if it is recalled for a minute today and every teacher does

it...today's lesson is completely new for the students and they do not know about that, only teacher knows what and how she/he will teach today.

In the statement, AUEO1 stated the importance of prior knowledge exploration for sustaining students' previous lesson as today's lesson is new for the students and they know nothing about it. This response explores AUEO1's somewhat comprehension of the importance of students' prior knowledge exploration.

Farther, stakeholders were asked about the scope of prior knowledge exploration of lessons in TE and TB. Among the responses, AUEO1's response was noticeable that illustrate below,

The information may be in TE and TB, but I couldn't get enough time to see that way. It is found in TE that; each lesson has 10-12 even 14-15 LO and this is too tuff for my teacher to complete one lesson with 10-12 LO in 35 minutes class of 50-70 students.

It appears from the statement that, AUEO1 was unaware of TB and TE as AUEO1 claimed time constrains for that. Moreover, the number of ILO that AUEO1 explained about TE is totally wrong. Therefore, AUEO1 has no comprehension of TB and TE information.

In addition, stakeholders were further asked about the classroom practice of students' prior knowledge exploration. The teacher had the reply that,

Prior knowledge is two types-it may be on today's lesson for getting lesson title or on the previous lesson to know how much they can memories or sustain their previous lesson. For example, today I sang a soil related song and will do other things for other days, so that students can understand that sir will ask question on that.

In the statement T1 explained, prior knowledge exploration is needed for sustain their previous knowledge or get the lesson title, which is going to teach today. This explanation expressed T1's somewhat comprehension of classroom practice of prior knowledge exploration.

Students' response in FGD

Students were asked about classroom practice of prior knowledge exploration. One of them had the reply that,

Usually, our class starts with reading a book. Sometimes, the teacher asked us questions on today's lesson or sometimes from the previous lesson.

The statement reveals that, T1's somewhat classroom practice of prior knowledge exploration.

Information provided in TB and TE

It is stated in the beginning of primary science textbooks of Bangladesh as “Major Feature of the Revised Primary Science Textbooks” that, enquiring of pupils’ prior knowledge and experience are tried to address in the lesson (NCTB, 2020). Analyzing the observed four lessons in curriculum documents it is found that, a very short introduction is placed at the starting of each before teaching-learning activity (Figure 4.5).

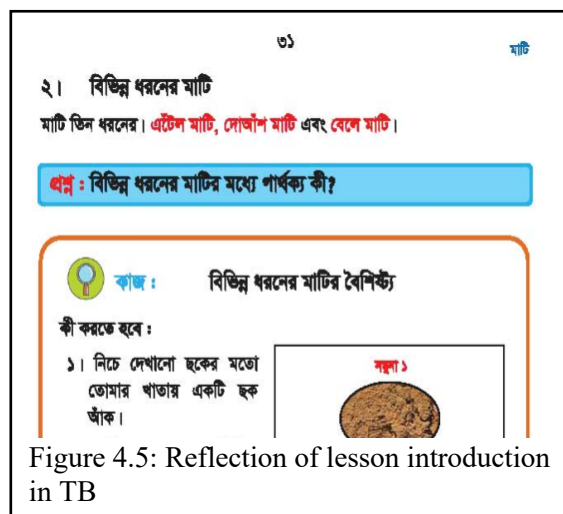


Figure 4.5: Reflection of lesson introduction in TB

পাঠ ১ : মাটির উপাদান পৃষ্ঠা ৩০ : [আমরা মাটির.....মাটিতে থাকে।] শিখনফল ৪.১.২ গঠন অনুযায়ী মাটি শনাক্ত করতে পারবে। উপকরণ - মাটির নমুনা (বিন্যাসের মাট থেকে) - খজ কাচের গ্লাস - পানি - নাড়ানোর জন্য কাটি - শিখন শেখানো কার্যাবলি [সূচনা] ১। বোর্ডে আজকের পাঠ শিরোনাম এবং অধ্যায় শিরোনাম লিখুন। ২। পূর্বজ্ঞান যাচাইয়ের জন্য প্রশ্ন করুন: ক) আমরা কোথায় বসবাস করি? খ) উদ্ভিদ কোথায় জন্মায়? ৩। আজকের পাঠের উদ্দেশ্য শিক্ষার্থীদের ব্যাখ্যা করুন : “আজকে আমরা মাটি সম্পর্কে জানব। মাটি কী? মাটি কী দিয়ে তৈরি? এটাই আমাদের আজকের পাঠের মূল প্রশ্ন। আমরা বিভিন্ন কাজের মাধ্যমে এই প্রশ্নের সমাধান করব।” ৪। বোর্ডে আজকের পাঠের মূল প্রশ্নটি লিখুন : মাটি কী দিয়ে তৈরি? Figure 4.6: Reflection of prior knowledge exploring question in first lesson in TE	প্রাথমিক বিজ্ঞান পাঠ ২ ও ৩ : বিভিন্ন ধরনের মাটি পৃষ্ঠা ৩১-৩২ : [মাটি তিন ধরনেরসহপাঠীদের সাথে আলোচনা কর।] শিখনফল ৪.১.১ মাটি কয় প্রকার তা বলতে পারবে। উপকরণ - মাটির তিনটি নমুনা (এটেল মাটি, বেলে মাটি এবং সোঁরাশ মাটি) - কাগজের শিট শিখন শেখানো কার্যাবলি ১। পূর্ব পাঠ পুনরালোচনা করুন : মাটির উপাদান কী কী? [সূচনা] ২। বোর্ডে আজকের পাঠ শিরোনাম এবং অধ্যায় শিরোনাম লিখুন। ৩। আজকের পাঠের উদ্দেশ্য শিক্ষার্থীদের ব্যাখ্যা করুন : “এখানে তিন ধরনের মাটি আছে। তিন ধরনের মাটির মধ্যে পার্থক্য কী? আমরা কীভাবে বিভিন্ন ধরনের মাটির মধ্যে ভুলনা করব? এটাই আমাদের আজকের পাঠের মূল প্রশ্ন। আমরা বিভিন্ন কাজের মাধ্যমে এই প্রশ্নের সমাধান করব।” ৪। বোর্ডে আজকের পাঠের মূল প্রশ্নটি লিখুন : বিভিন্ন ধরনের মাটির মধ্যে পার্থক্য কী? Figure 4.7: Reflection of prior knowledge exploring question in lesson after first lesson in TE
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Usually, teacher use it for prior knowledge exploration, that was also found in lesson observations and in interviews. Moreover, in the beginning of teacher's edition there is an

instruction for teachers that, explore students' prior knowledge at the starting of a lesson through the related question (NCTB, 2020).

Analyzing the observed lessons in TE it is found that, TE addressed prior knowledge exploring questions for the first lesson of a chapter (Figure 4.6), and addressed questions of review of the previous lesson for the rest lessons (Figure 4.7). Although the lessons in a chapter are interrelated and all lessons contain some new additions; therefore, exploring students' prior knowledge is needed besides reviewing the previous lesson in each lesson. Consequently, the Information provided for prior knowledge exploration in TE has been considered as somewhat addressed.

A summary of the findings of documents analysis, lesson observations and stakeholders' comprehension regarding prior knowledge exploration is presented in table 4.9.

Table 4.9: Summary of findings about exploring students' prior knowledge

Stakeholders	Stakeholders' comprehension about exploring students' prior knowledge			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of exploring students' prior knowledge	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Not comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lesson: 1	lessons-1: somewhat practiced	Somewhat addressed	Somewhat addressed
					Chapter:5 Lessons: 2&3		Somewhat addressed	Somewhat addressed
PTI instructor	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lessons: 4&5	lessons-2: somewhat practiced	Somewhat addressed	Somewhat addressed
URC instructor	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Not comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Did not address	Somewhat addressed

The findings reveal that teacher and concerned stakeholders have somewhat comprehension of exploring students' prior knowledge. However, teacher sometimes explore students' prior knowledge in the science classroom. Moreover, the information of exploring students' prior knowledge is somewhat addressed in textbooks (TB) and in teacher's edition (TE).

➤ Overall remarks

Teacher1's somewhat comprehension of exploring students' prior knowledge was reflected in T1's lessons practice as T1 somewhat explore students' prior knowledge in the science classroom. However, concerned stakeholders' somewhat comprehension may also be reflected in teacher's comprehension and classroom practices. Moreover, the somewhat addressed information in curriculum documents may also be reflected in T1 and concerned stakeholders' comprehension.

4.2.3. Real-life orientation of science concept

Teacher's classroom practice

It has been observed in lesson observations that, the teacher tried to orient the science concepts with some real-life examples and with a very small amount of real material in own way. However, the number of supplied teaching aid was not sufficient for teaching learning activities in all the observed classes of T1; and that is considered somewhat practiced. Out of four observed lessons of T1, one lesson is shown in table 4.10 as the teacher's classroom activity.

Table 4.10: Teacher 1's classroom practice about real-life orientation of science concept at Grede-3, Chapter-Soil

ILO	Lesson in TE	Lesson title	No. of class taken by the teacher	Teaching learning activities and examples given in TB	Examples given in TE	Teacher's classroom activity
4.1.2	1	Components of soil	Lesson-1	Collect soil from outside the class and identify soil elements	Collect soil from outside the class and identify soil elements	Carried only 3 cups of sample soil
4.1.1	2 & 3	Different types of soil		Observe and identify 3 types of soil properties	Observe and identify 3 types of soil properties	

Stakeholders' views

Orientation of science concepts in real-life emphasizes the importance of the application of skills and values in real-life situations, participation in physical activity, community organizations and initiatives (Jenkins et al., 2006). To know about the necessity of linking real-life situations with science concepts, stakeholders were asked question. PTI instructor1 replied,

Linking science concepts with real life is very important to make the learning effective and sustainable. For example, the teacher shows two glasses of water (pure and polluted) and asks which glass do you want to take? If they can't explain the reason then the teacher will explain the cause and effect of polluted water. Finally, ask them, what they will do about their family members?

In the statement, PTI instructor1 explained the necessity of real-life orientation with science concepts for effective and sustainable learning; that reveals PTI instructor1's moderate comprehension.

Moreover, the topics and examples of all the chapters are more or less related to our daily life; such as Our environment, materials, food, energy, natural resources, technology, first aid etc. (NCTB, 2020). In response to the asked question about the scope of linking real-life situations with science concepts in a lesson in TE and TB, the teacher1 said,

I can't follow TE that way but follow TB, the science concept of TB is aligned with students' real life so that they can understand it easily. For example, in chapter soil TB provided information of soil characteristics and which plants grow in which soil. So, students can easily identify soil and grow plants.

The statement explores T1's unawareness of TE information as T1 said not to follow TE that way.

Furthermore, according to Yoshida (2004), science classes should be related to children's experience in the environment and daily life. To know the stakeholders view, they were asked to respond about the classroom practice of linking real-life situation with science concepts. Among the stakeholders, AUEO1 alluded,

The students can't read properly, so their main target is to read the text clearly first then understanding science concepts, but the class time is limited and the students' number is more, they can't manage everything in a time.

The statement expresses AUEO1's unawareness about science teaching learning as AUEO1 cited excuses for not linking science concepts with real life in the science classroom.

Students' response in FGD

In response to the asked question about the classroom practice of orienting science concepts with real life, one of them replied that,

Teacher tries to give example of our known things from daily life and sometimes carry sample materials in class. However, the sample materials are too limited that we can't follow the sample materials.

The statement of the student expresses that the teacher¹ did not focus on the orientation of science concepts to real life that way.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, the topics and examples of all the chapters are more or less related to our daily life; such as Our environment, materials, food, energy, natural resources, technology, first aid, etc. (NCTB, 2020).

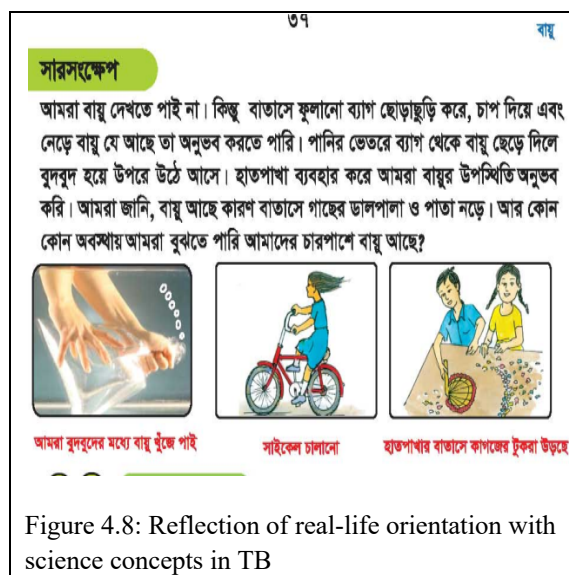


Figure 4.8: Reflection of real-life orientation with science concepts in TB

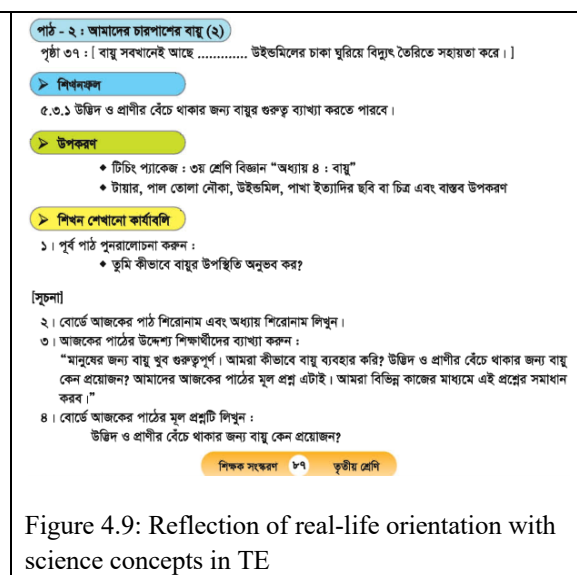


Figure 4.9: Reflection of real-life orientation with science concepts in TE

Both TB and TE provided some real-life examples connecting with science concepts (Figures 4.8 & 4.9). The finding of documents analysis, lesson observations and stakeholders' comprehension regarding orientation of science concepts with real life are summarized in the table 4.11.

Table 4.11: Summary of findings about real-life orientation in science concept

Stakeholders	Stakeholders' comprehension regarding real life orientation in science concepts			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of orienting science concept in real life	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Moderately comprehend	Somewhat comprehend	Moderately comprehend	Moderately comprehend	Chapter:5 Lesson: 1	lessons-1: somewhat practiced	Moderately addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Moderately addressed
PTI instructor	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter:5 Lessons: 4&5	lessons-2: somewhat practiced	Moderately addressed	Moderately addressed
URC instructor	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Moderately addressed	Moderately addressed
AUEO	Moderately comprehend	Somewhat comprehend	Did not comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Moderately addressed	Moderately addressed

The findings of table reveal that, teacher1 and concerned stakeholders mostly have moderate comprehension of real-life orientation in science concept. T1 somewhat orient science concept with real life. The information of orientation real life in science concept, moderately addressed both in textbooks (TB) and in teacher's edition (TE).

➤ Overall remarks

Teacher1's moderate comprehension about orientation of science concept with real life somewhat reflected in the science classroom. However, concerned stakeholders' moderate comprehension may also be reflected in T1's comprehension and classroom practices. Moreover, the moderately addressed information in curriculum documents may also be reflected in T1 and concerned stakeholders' moderate comprehension.

4.2.4 Science process skills

Esler (2001) claimed that modern elementary science curriculum emphasized to acquire appropriate science concepts or information and to develop science process skills for doing science.

Teacher's classroom practice

It has been explored from the observed lessons that, T1 somewhat practiced and sometimes

did not practice science process skills in science classes. The teacher's classroom practice focusing science process skill of a lesson is shown in table 4.12, where T1 somewhat focuses on science process skills.

Table 4.12: Teacher 1's classroom practice of science process skills in Grade-3, Chapter-Soil

ILO	Lesson in TE	Lesson title	No. of classes taken by the teacher	Science process skills are given in TB	Science process skills are given in TE	Teacher's classroom activity
4.1.2	1	Components of soil	lesson-1	Observation	Observation	did not do
4.1.1	2 & 3	Different types of soil		Observation decision making	Observation Prediction/ decision making	somewhat focus on observation

Stakeholders' views

Science process skills are considered as necessary tools to produce and use scientific information, to perform scientific research, and to solve problems; that can be gained by students through certain science education activities (Harlen, 1999; Huppert et al., 2002). Stakeholders were asked 'What are the opportunities of students for achieving science process skills through science learning?'. URC instructor1 alluded,

Students can observe, measure, count and classify etc. in their daily life. Science learning helps to develop these skills. For example, they can separate food items or plants or measure their seating table, books etc.

According to URCI1, students can gain some skills for their daily life through science learning. However, the main purpose of achieving science process skills is absent in the explanation, which express URCI1's somewhat comprehension of science process skills.

Moreover, Esler (2001) claimed that modern elementary science curriculum emphasized to acquire appropriate science concept or information and to develop science process skill for doing science. In response to the question about the information provided in TE and TB about the opportunities for students, PTI instructor1 said,

TB approach is scientific inquiry; all the science concepts of TB focus on different activities which need science process skills. TE also mentioned science process skills but I did not follow it that way.

In the statement, PTII1 stated the information provided in TB but does not follow TE that way that reveals PTII1's unawareness of TE.

Helgeson (1992) stated that the most effective approach to teaching science is to integrate science process skills; and science concepts using hands-on activities which focus on specific problem-solving skills. On the basis of asked question about the classroom practice of achieving science process skills through science learning, teacher 1 said,

I do not know about science process skills that way, but I try to follow the activities which are given in TB.

In the statement, T1 alluded to lack of knowledge about science process skills but follow TB's instructions during activities, which indicates T1's somewhat comprehension.

Students' response in FGD

In response to the asked question about the classroom practice of achieving science process skills through science learning, one student of FGD asserted,

Usually, we do not get the chance to do any activity in science classes. Sometimes teacher did it only in front of the class by own self.

From the statement it is expose that, T1 did not focus on science process skills in science classroom.

Information provided in TB and TE

২। বিভিন্ন ধরনের মাটি

মাটি তিন ধরনের। এটেল মাটি, দোআঁশ মাটি এবং বেলে মাটি।

প্রশ্ন : বিভিন্ন ধরনের মাটির মধ্যে পার্থক্য কী?

কাজ : বিভিন্ন ধরনের মাটির বৈশিষ্ট্য

কী করতে হবে :

- ১। নিচে দেখানো ছকের মতো তোমার খাতায় একটি ছক আঁক।
- ২। একটা খবরের কাগজ বিছিয়ে তার ওপর তিন ধরনের মাটি রাখ।
- ৩। তিন রকমের মাটি পর্যবেক্ষণ করে বৈশিষ্ট্যগুলো ছকে লেখ।
- ৪। তোমার কাজ নিয়ে সহপাঠীদের সাথে আলোচনা কর।

Figure 4.10: Reflection of science process skills in TB

দলীয় কাজ।

- ৫। কতগুলো দল গঠন করুন।
- ৬। বোর্ডে একটি গ্রাসের ছবি আঁকুন এবং শিক্ষার্থীদের খাতায় ছবিটি আঁকতে বলুন।
- ৭। প্রত্যেক দলকে মাটির নমুনা, একটি গ্রাস এবং পানি সরবরাহ করুন। (দ্রষ্টব্য : শিক্ষক পাঠের পূর্বেই মাটি সংগ্রহ করে রাখবেন।)
- ৮। শিক্ষার্থীদের কার্য সম্পাদনের প্রক্রিয়াটি ব্যাখ্যা করুন এবং কাজটি করতে বলুন।
- ৯। শ্রেণিকক্ষে ঘুরে শিক্ষার্থীদের কার্য সম্পাদনে সহায়তা করুন। [মূল্যায়ন : শিক্ষার্থীরা গ্রাসের চিত্রে নির্দেশনা মতো উপাদান চিহ্নিত করেছে কিনা যাচাই করুন। (প্রক্রিয়াকরণ দক্ষতা : পর্যবেক্ষণ)]

[সারসংক্ষেপ]

Figure 4.11: Reflection of science process skills in TE

It is clearly stated in the beginning of textbooks as “Major features of the revised primary science textbooks” to emphasis on problem-solving based learning in primary science that learning activities aimed in the acquisition of science process skills necessary for children to solve the problem (NCTB, 2020).

Analyzing the primary science text books and teacher’s edition it is found that, there are some activities in each lesson focusing science process skills like; demonstration, observation, experiment, investigation, decision making (NCTB, 2020). Figure 4.10, reflects science process skill of a lesson in TB. Here, observation skill is mentioned for identifying different types of soil. Figure 4.11, reflects science process skills in TE where also observation skills is mentioned.

The findings about science process skills from documents analysis (TB & TE), lessons observation and stakeholders’ comprehension are summarized in the table 4.13.

Table 4.13: Summary of findings about science process skills

Stakeholders	Stakeholders’ comprehension about science process skills			Overall comprehension	Chapter & lesson in Grade three	Teacher’s lesson practice	Information provided (Based on literature review)	
	Importance of science process skills	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Do not comprehend	Do not comprehend	somewhat comprehend	Do not comprehend	Chapter:5 Lesson: 1	lessons-1: somewhat practiced	Somewhat addressed	Somewhat addressed
					Chapter:5 Lessons: 2&3		Somewhat addressed	Somewhat addressed
PTI instructor	Moderately comprehend	Somewhat comprehend	Moderately comprehend	Moderately comprehend	Chapter:5 Lessons: 4&5	lessons-2: somewhat practiced	Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Did not address	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Did not address	Did not address

The findings of table reveal that, concerned stakeholders have moderate to somewhat comprehension of science process skills. T1 did not comprehend science process skills; but somewhat focused on science process skills in the science classroom. Science process skills somewhat addressed and sometimes did not address, in the observed lessons of TB and TE.

➤ Overall remarks

Though T1's did not comprehend science process skills but it did not reflect in T1's science classroom practice. However, concerned stakeholders' mostly somewhat comprehension did not reflect in T1's comprehension. Moreover, the somewhat addressed information of science process skills in curriculum documents may also be somewhat reflected in concerned stakeholders' comprehension and T1's classroom practice.

4.2.5 Activity-based class

Several literatures have argued that activity-based class affects students learning in science and the learners can develop their ideas by the capacity to their own thoughts and experiences.

Teacher's classroom practice

It has been explored from the observed lessons that, T1 did the activities by own self with only one set of materials in front of the class. Students could not follow the activities that way, so could not understand any of these activities. Therefore, T1 has somewhat practiced the activity-based class. Table 4.14 presents T1's classroom activity of activity-based class.

Table 4.14: Teacher 1's classroom practice about activity-based class in Grade-3, Chapter-Soil

ILO	Lesson at TE	Lesson title	No. of classes taken by the teacher	Given activities in TB	Given activities in TE	Teacher's activity in classroom
4.1.3	4 & 5	Soil and crops	lesson-2	-Activity of water holding capacity of soil -Share with the class	Group work: Activity of water holding capacity of soil	Partially did the activity by own self

In the four observed lessons of T1, TB addressed activities as single work whereas in TE it is instructed as group work. The provided information may create confusion to the stakeholders. Table 4.14 highlighted that the teacher somewhat practiced activity-based classes. The teacher carried a few apparatuses for the activities and did it by own self in front of the class. So, the students could not follow it that way and did not get the chance to do the science activities on their own.

Stakeholders' views

The important feature of activity-based teaching-learning is that it is learner centered which encourages self-learning; it also allows the learner to study according to the learners' own ability and skills (Lakshmi, 2005). Stakeholders were asked about the importance of activity-based classes for science teaching-learning. In response, URC instructor1 said that,

Learning with activities is an activity-based class. The teacher engages the students within groups so that the students can learn through group work.

In the statement, URCI1 stated activity-based class as group work instead of learners' self-learning with their own ability and skills that reveal URCI1's somewhat comprehension of activity-based class.

Analyzing the existing primary science textbooks and teacher's edition it is found that there are activities in each lesson (Figures 4.10 & 4.11). In response to the question about the provided information on opportunity for activity-based classes in TE and TB, AUEO1 replied,

TB mentioned group work in maximum lessons to active the students but I can't say about TE. For example, it is instructed in maximum lessons of TB that discuss with others and draw a conclusion.

In the statement, AUEO1 stated the information of TB but was unaware of TE provided information; that reveals AUEO1's somewhat comprehension of the provided information of TE and TB.

According to Rillero (1994), a child learns science by learning with doing. Learning science is not only limited to reading or hearing but it requires students' laboratory work to test ideas and develop understanding (Ewers, 2001). Stakeholders were asked about the classroom practice of activity-based classes. Teacher1 stated that,

for example, yesterday I gave one type of soil sample to each column of students and told them to pass it behind. I always try to find out the lesson with students group discussion. However, due to space limitations and large number of students, I could not engage them in group work for group discussion. If the science materials are very easy and available then we try to engage the students into group work.

In the statement, T1 explained activity-based learning as group work with group discussion. However, this statement reveals T1's somewhat comprehension about activity-based learning as T1 wanted to engage students into group discussion without focusing activity.

Students' response in FGD

Students of FGD were asked about the classroom practice of activity-based class. One of them had the reply that

Usually, we do not get the chance to do any activity in science classes. Sometimes teacher did it only in front of the class by own self.

The statement explores T1's classroom practice that T1 did not practice activity in the science classroom.

Information provided in TB and TE

It is clearly stated in the beginning of primary science textbooks as 'Major features of the revised primary science textbooks' to enhancement of learning activities in primary science that introduction of a variety of experiments, demonstration, observation and investigation to promote scientific attitude of the pupils (NCTB, 2020). Analyzing the existing primary science textbooks and teacher's edition it is found that there are activities in each lesson (Figures 4.12 and 4.13).

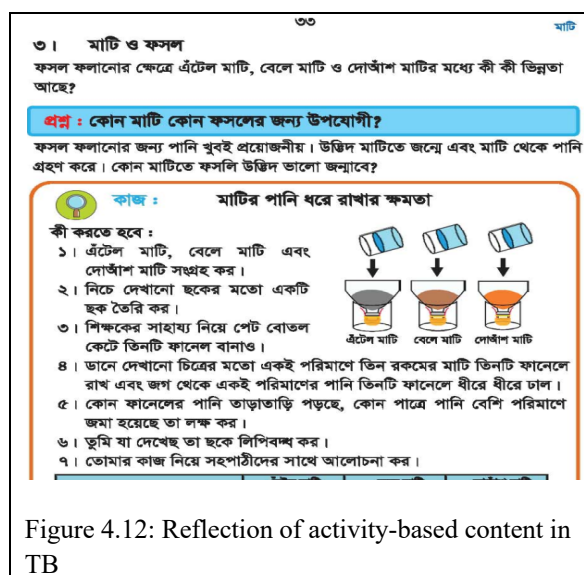


Figure 4.12: Reflection of activity-based content in TB

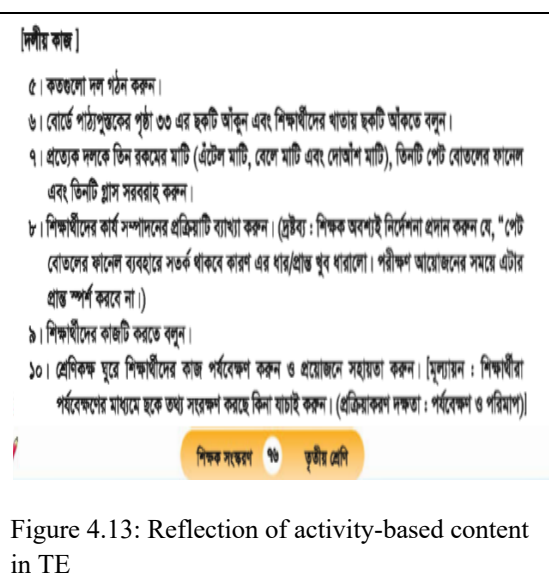


Figure 4.13: Reflection of activity-based content in TE

A summary finding of activity-based class from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in table 4.15.

Table 4.15: Summary of findings about activity-based class

Stakeholders	Stakeholders' comprehension about activity-based class			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of activity in science class	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lesson: 1	lessons-1: somewhat practiced	Moderately addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Moderately addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lessons: 4&5	lessons-2: somewhat practiced	Moderately addressed	Moderately addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Moderately addressed	Moderately addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Moderately addressed	Moderately addressed

The findings of the table reveal that T1 and concerned stakeholders have somewhat comprehension about activity-based classes. T1 is somewhat focused on activity in the science classroom. Moderate information has been provided in TB and TE for activity-based classes.

➤ Overall remarks

Teacher 1's somewhat comprehension of activity-based science class was reflected in T1's classroom practice. Concerned stakeholders' somewhat comprehension may also be reflected in T1's comprehension and classroom practices. Moreover, though curriculum documents moderately addressed the information but it did not reflect on T1 and concerned stakeholders' comprehension.

4.2.6 Collaborative approach

Teacher's classroom practice

Out of four observed lessons, the teacher did not seat the students into groups for group activity or group discussion. Therefore, the students did not get the chance to cooperate with each other during the with or share their idea about the lessons. The teacher's focus was only on reading the text. The teacher's classroom activity of a lesson is shown in table 4.16 next.

Table 4.16: Teacher 1's lesson practice of activity-based class in Grade-3, Chapter-Soil

ILO	Lesson in TE	Lesson title	No. of class taken by the teacher	Collaborative approach is given in TB	Collaborative approach is given in TE	Teacher's activity in classroom
4.1.3	4 & 5	soil and crops	Lesson-2	Do the activity and share your idea with the class	Group work: Do the activity with groups	did the activity by his own only one set materials

Stakeholders' views

Collaborative approach is essential to develop students 21st skills (Wismath & Orr, 2004). Collaborative approach is considered an essential tool for dealing with complex problem (Griffin et al., 2015). Stakeholders were asked for their opinion about collaborative approach in science teaching-learning. Teacher1 said,

Collaborative learning is the learning where students can learn with group discussion. But students could not understand the TB instruction or words and I have to do the activity first then the students follow it. For example, I told them the soil characteristics first, then told them to discuss it in groups, so they can memorize it and their learning will be sustained.

The statement expresses T1's level of understanding about collaborative approach. Here, T1 explained the collaborative approach as group work or group discussion but the teacher has to do the work first then the students follow because the activity is new to the students. This explanation expressed T1's somewhat comprehension of collaborative approach.

Analyzing the new primary science textbooks and teacher's edition, it is found that there is mentioned to discuss with classmates as well as instructed group activities in all lessons. Stakeholders were asked about the opportunity of collaborative approach mentioned in TE and TB. Among the stakeholders, AUEO said,

There is no instruction about group work in TB and I did not see TE that way. But in PTI training, the trainee teacher has been trained up with hands on activities. Thus, they can get an idea of group work.

The statement states that AUEO1 was unaware about the information and AUEO1 did not comprehend the provided information in TB and TE.

Besides, students learn well when working collaboratively rather than individually (Vygotsky, 1978). Stakeholders were asked about the practice of collaborative approach

in classroom. URC Instructor1 said,

The higher authority has given the instruction of group work, so the teacher engage the students into group work. But the teacher was unable to do it when the students' number is too large.

URC instructor1 explained collaborative approach as group work in classroom practice. However, the comprehension of URCI1 was somewhat about classroom practice of collaborative approach as URCI1 expressed excuses for not practicing in the classroom rather than the importance of collaborative approach.

Students' response in FGD

Students of FGD were asked about the classroom practice of collaborative approach. One of them replied,

Usually, we do not get the chance to do any activity in science classes. Sometimes we seated into groups and fill up the given chart and table following textbooks, but it's very rare for us, maximum time we do it following the teacher's instruction on the board.

The statement of the student reveals that, T1 did not practice collaborative approach in the science classroom.

Information provided in TB and TE

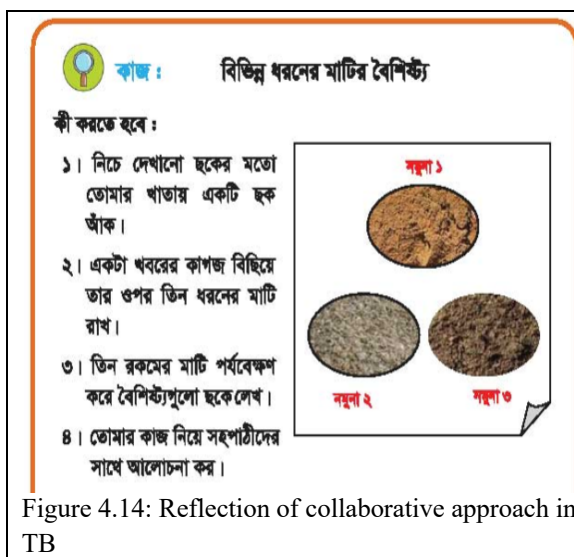


Figure 4.14: Reflection of collaborative approach in TB

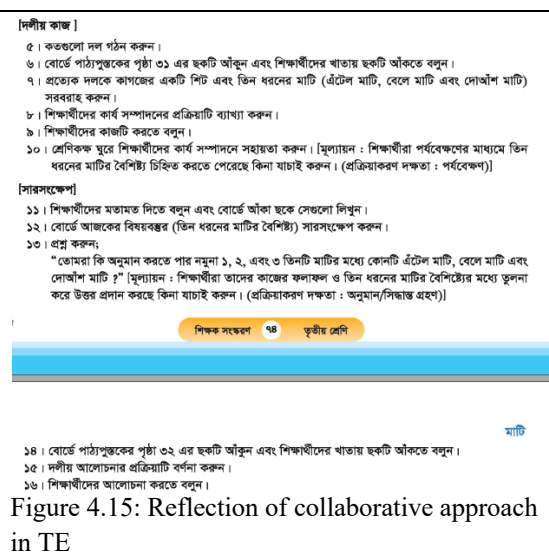


Figure 4.15: Reflection of collaborative approach in TE

The elementary science textbooks are mentioned to discuss with classmates as well as instructed group activities in all lessons (NCTB, 2020). It is clearly stated in the beginning of textbooks titled “Major features of the revised primary science textbooks” as enhancement of learning activities that introduction of the group discussion activities to foster communication skills, expression ability and positive attitude of the pupils.

There is also introduced two characters to make lesson easy to understand and attractive for the students as a part of promoting collaborative attitude (NCTB, 2020). Analyzing the primary science textbooks and teacher’s edition of observed lessons, it is found that there is mentioned to discuss with classmates in TB (Figure 4.14) and instructed group activities with group discussion in TE (Figure 4.15).

The figures expose that, collaborative approach in science teaching learning somewhat addressed in TB and moderately addressed in TE. In all the observed lessons, TB addressed ‘Do the activity and share your idea with the classmates whereas in TE it is mentioned as ‘make some groups, do the work and discuss’. The provided information may create confusion to the stakeholders. The findings of collaborative approach from documents analysis, lesson observations and stakeholders’ comprehension are presented in the next table 4.17.

Table 4.17: Summary of findings about collaborative approach

Stakeholders	Stakeholders’ comprehension about collaborative approach			Overall comprehension	Chapter & lesson in Grade three	Teacher’s lesson practice	Information provided (Based on literature review)	
	Importance of collaborative approach	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lesson: 1	lessons-1: did not practice	Somewhat addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Somewhat addressed	Moderately addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lessons: 4&5	lessons-2: did not practice	Somewhat addressed	Moderately addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	lessons-3: did not practice	Somewhat addressed	Moderately addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: did not practice	Somewhat addressed	Moderately addressed

The findings of table reveal that T1 and concerned stakeholders have somewhat comprehension of the collaborative approach. T1 did not focus collaborative approach in

the science classroom. The information of the collaborative approach has been somewhat addressed in TB, and moderately addressed in TE.

➤ Overall remarks

Teacher1's somewhat comprehension of collaborative approach was reflected in T1's classroom practice. However, concerned stakeholders' somewhat comprehension may also be reflected in T1's comprehension and classroom practices. The somewhat to moderately addressed information of collaborative approach in curriculum documents may also be reflected in T1 and concerned stakeholders' comprehension.

4.2.7 Illustrations (Pictures and Photographs)

Proper and relevant illustrations play a strong role to understand the concepts and make students interested (Bishop, 1989).

Teacher's classroom practice

There are content related photographs and illustrations for activities and examples in TB. The teacher did not focus on any illustrations or photographs provided in TB and TE that way. The teacher gave only some examples of his own in two classes; that is mentioned as somewhat practice in table 4.18. One of teacher's classroom practices is presented in table 4.18 next.

Table 4.18: Teacher 1's classroom practice about illustrations in Grade-3, Chapter-Air

ILO	Lesson in TE	Lesson title	No. of classes taken by the teacher	Given illustrations in TB	Given illustrations in TE	Activities done by the teacher
5.3.1	2	air around us (2)	lesson-4	Illustration showing the uses and importance of air	-	gave only some examples of his own

Stakeholders' views

Students can interact with content by using appropriate diagrams (Thomas & Yoon Hong, 2001). Stakeholders were asked about the importance of illustrations to achieve content knowledge. URC Instructor1 replied,

Illustrations and diagrams, provided in TE and TB are very important for students' content knowledge. Our teacher does not carry any teaching aid as supporting material for the content, they only conduct the class through lecture method. The illustration and diagrams help students to understand content knowledge.

In the statement, URCI1 stated the importance of illustrations as the alternative of teaching aids though the teacher does not carry teaching aid that way. However, teaching aid and illustrations these all are supporting materials for text; not alternatives for each other. URCI1 has somewhat comprehension of illustrations.

There are used a large number of illustrations, pictures and diagrams in textbooks with proper labeling which are relevant to the concepts (NCTB, 2020). In addition, stakeholders were asked about the consistency of the text and Illustrations mentioned in TE and TB. T1 alluded,

Illustrations and diagrams of the TB are very important and help me to conduct science classes. I conduct the classes with my own plan and get help from the TB, but did not think of the consistency of text and the illustration and diagram that way.

The statement reveals T1's unawareness about the provided illustration in TB that T1 did not observe the consistency of the text and provided illustrations; that reveals T1's somewhat comprehension of TB.

Participants were asked about the practice of illustration and diagram in classroom. AUEO1 replied,

Students are fascinated with color illustration and teachers use TB illustration, teachers need enough time and resources to make lesson related illustration-based teaching aid, the number is too less where teachers can get time to prepare or use illustration-related teaching aid.

The statement expresses that, AUEO1 has somewhat comprehension of classroom practice of illustrations as AUEO has given excuses for not using illustration rather than its importance.

Students' response in FGD

Students of FGD were asked about the classroom practice of illustrations and diagrams.

One of them replied,

Usually, our classes conduct by reading text from textbooks, and then we notice the picture from textbooks.

The statement of the student reveals that the teacher somewhat focused illustrations and photographs in the science classroom.

Information provided in TB and TE

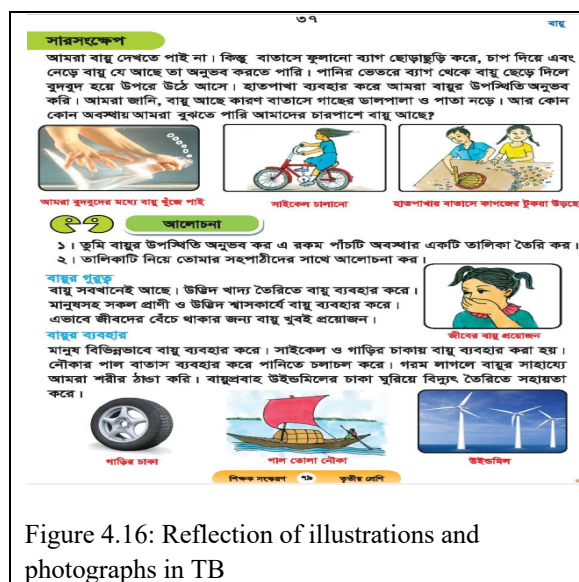


Figure 4.16: Reflection of illustrations and photographs in TB

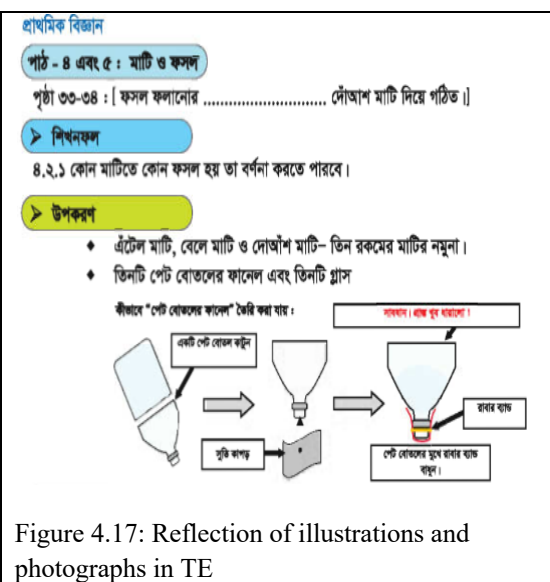


Figure 4.17: Reflection of illustrations and photographs in TE

At the beginning of textbooks, it is mentioned as “Major features of the revised primary science textbooks” that-user friendly clear titles, subtitles, and a large number of illustrations and photographs are presented. There also mentioned that abstract things of science are portrayed with pictures/photographs as well as proper descriptions (NCTB, 2020). Analyzing the existing primary science textbooks and teacher’s edition it is found that, the topics and examples of all the chapters are more or less related to our daily life.

Moreover, it is found from the observed lessons that, there are content related photographs and illustrations for activities and examples in TB. Therefore, science concept related photographs are available, that helps students to understand science concept linking with real life. However, in some cases illustrations are provided rather than photographs. It might be more relevant to the content if photographs are provided.

The findings of provided illustration from document analysis (Figures 4.16 & 4.17), lesson observations and stakeholders' comprehension are presented in the table 4.19. Students FGD were also exhibited in the interview section.

Table 4.19: Summary of findings about illustrations

Stakeholders	Stakeholders' comprehension about illustrations			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of illustrations	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lesson: 1	lessons-1: did not practice	Moderately addressed	Somewhat addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Did not address
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lessons: 4&5	lessons-2: did not practice	Moderately addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Moderately addressed	Did not address
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Moderately addressed	Did not address

The findings of table reveal that, T1 and concerned stakeholders have somewhat comprehension of content-related illustrations. T1 somewhat focused on illustrations in the science classroom; but sometimes did not focus. Related illustrations are moderately addressed in TB, but mostly did not provide in TE.

➤ Overall remarks

Teacher1's somewhat comprehend of the approaches of illustrations was reflected in T1's classroom practice. However, concerned stakeholders' somewhat comprehension may also be reflected in the T1's comprehension and classroom practices. Though the illustrations are moderately addressed in the curriculum document; it may not be reflected in T1 and concerned stakeholders' comprehension accordingly.

4.2.8 Scope of scientific inquiry

The basic layout of textbooks follows the sequences of a problem-solving approach, which is a kind of inquiry. Moreover, the learning activities of primary science textbooks and teacher's edition are aimed at the acquisition of scientific process skills necessary for learners to solve the problem through scientific inquiry (NCTB, 2020).

Teacher's classroom practice

Four lessons of T1 have been observed. The findings of one observed lesson are presented in the table 4.20, where it is explored that, T1 did not engage the students with scientifically oriented questions; supplied only one cup of each soil sample for the whole class, and said the students to see and pass it to others. T1 did not practice inquiry in science classroom. The students did not get the chance to do the activity; collect data and finally formulate, evaluate or justify the explanation that way.

Table 4.20: Teacher 1's classroom practice about illustrations in Grade-3, Chapter-Soil

ILO	Lesson in TE	Lesson title	Lesson taken by the teacher	Information is given in TB	Information is given in TE	Teacher's classroom practice
4.1.1	2 & 3	different types of soil	Lesson-1	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify explanation	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify the explanation	*did not formulate the problem * Supplied only one cup of each soil sample, and said the students to see and pass it to others

Stakeholders' view

According to Anderson's (2002) review, the use of inquiry in science education is defined as scientific inquiry, inquiry learning, and inquiry teaching. Stakeholders were asked for their opinion about inquiry-based teaching. PTI instructor1 said,

The concept of inquiry is that primary science in primary school has a system of exploratory work in each chapter. The teaching learning activities has arranged to highlight the 5 steps of inquiry: invite the investigation with key question, to organize the investigation work, formulate ideas, change ideas and application.

The statement expresses the concept of PTII1 about inquiry-based teaching, where PTII1 stated inquiry into basic five steps. PTII1 was knowledgeable about the inquiry but not completely informed in explanation. Therefore, PTII1 was moderately comprehend of inquiry-based teaching.

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is an introduction of variety of experiments, demonstration, observation and investigation activities to promote scientific attitude for scientific inquiry. Stakeholders

were asked about the opportunity for inquiry-based teaching mentioned in TE and TB. The teacher1 said,

TB mentioned different types of activities in each lesson for activity base class. For example, in case of different types of soil there has been mentioned of supplying soil samples, so that the students observe the soil and identify its characteristics.

In the statement, T1 mentioned the provided activities of the students for activity-based class in TB. T1 did not comprehend inquiry-based teaching.

Inquiry learning and inquiry teaching occur in the classroom, typically in the same time, and are often referred to as inquiry-based teaching-learning (Southerland et al., 2007). Participants were asked about the practice of inquiry in science classroom. AUEO1 said,

It is very tough to get activity-based class in science learning. One or Two teachers make that kind of knowledge a little better, the teaching capacity is a little different, the number is very insignificant.

AUEO1 stated inquiry-based teaching as activity-based class in the above statement that reveals AUEO1 did not comprehend about classroom practice of inquiry.

Students' response in FGD

Students of FGD were asked about their way of learning through inquiry. One of them stated that

Actually, we could not get the chance to do any activity in the science classroom. Maximum time our class conducts through text reading from the textbook and the teacher asks us questions to evaluate.

The student asserted that the teacher did not focus inquiry-based teaching to conduct a lesson.

Information provided in TB and TE

It is mentioned in “Major features of the revised primary science textbooks” that the introduction of a variety of experiments, demonstration, observation and investigation activities to promote a scientific attitude to scientific inquiry (NCTB, 2020). Analyzing the

Table 4.21: Summary of findings about inquiry-based teaching

Stakeholders	Stakeholders' comprehension about inquiry based teaching			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of inquiry based teaching	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lesson: 1	lessons-1: somewhat practiced	Moderately addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Moderately addressed
PTI instructor	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter:5 Lessons: 4&5	lessons-2: somewhat practiced	Moderately addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Moderately addressed	Moderately addressed

The findings of table reveal that T1 and concerned stakeholders mostly did not comprehend inquiry-based teaching. T1 did not practice inquiry in the science classroom. The inquiry-based teaching approach is moderately addressed in TB and in TE.

➤ Overall remarks

Teacher1's comprehension of inquiry-based teaching was reflected in T1's classroom practice as T1 did not practice it. Concerned stakeholders mostly did not comprehend; that may be reflected in T1's comprehension and classroom practices. Though curriculum documents moderately provided the information of inquiry teaching; but it may not be reflected in T1 and concerned stakeholders' comprehension.

4.2.9 Lesson summary

Teacher's classroom practice

The teacher randomly instructed students to read the text after teaching learning activities in all the observed classes; that is mentioned as somewhat practice in table 4.23. One of the teacher's classroom practices is presented in table 4.22 next.

Table 4.22: Teacher 1's classroom practice about lesson summary in Grade-3, Chapter-Air

ILO	Lesson in TE	Lesson title	No. of classes taken by the teacher	Summary given in TB	Summary given in TE	Activities done by the teacher
5.1.1	1	air around us (1)	Class-3	content related text	Same as above	a few students read the summary

Stakeholders' views

During the mid-1970s and early 1980s, cognitive psychologists (Kintsch, 1974; van Dijk & Kintsch, 1983) made this clear in a series of studies with teachers, that summarizing strategies have a substantial average effect on student understanding of academic content. However, stakeholders were asked for their opinion about the importance of the lesson summary. PTI Instructor said,

Lesson summary is the end part of the total lesson where the whole lesson is expressed shortly. When learning outcomes are achieved by the students through teaching -earning, then the teacher summarizes the whole lesson shortly and starts the assessment part. So, lesson summary is very important for students learning. I found it in TB but did not notice in TE that way.

In the statement, PTII1 mentioned lesson summary as the end part of total lesson, needed for students' assessment; that explores PTII1's somewhat comprehension of summary.

Moreover, stakeholders were asked for their opinion about the information provided in TE and TB. Teacher1 said,

I try to follow TB and noticed it in TB but did not give more attention on it.
I did not follow TE that way.

In the statement, T1 expressed that T1 notice it but did not give more attention on summary in TB. This explore T1's somewhat comprehension about summary.

Furthermore, several researchers found that using a summary effectively helps to increase students' understanding of content (Haystead & Marzano, 2009). Stakeholders were asked about the practice of lesson summary in classroom. AUEO1 replied,

Our primary level students could not read properly, so the main target of our teacher is to read out the text by the students and they do it again and again.

In the statement, AUEO1 emphasized the practice of lesson summary is for students' memorization through reading the text again and again rather than their understanding, that express the somewhat comprehension of AUEO.

Students' response in FGD

Students of FGD were asked about the classroom practice of lesson summary. One of them replied,

Usually, the teacher instructs us to read this text again and again to memorize lessons, we do it in groups or individually.

The statement of the students reveals that the teacher wanted the students to memorize the text by reading it over and over again.

Information provided in TB and TE

Analyzing the existing primary science textbooks, it is found that there is presented a summary in each lesson after the activity. It is also clearly stated at the beginning of textbooks as “Major features of the revised science textbooks” that each lesson is presented through grade fitting simple texts and child friendly summary (NCTB, 2020). Analyzing the existing primary science textbooks and teacher's editions it is found that, summary is placed as content text in TB, whereas TE highlighted it as the end part of teaching learning activities.

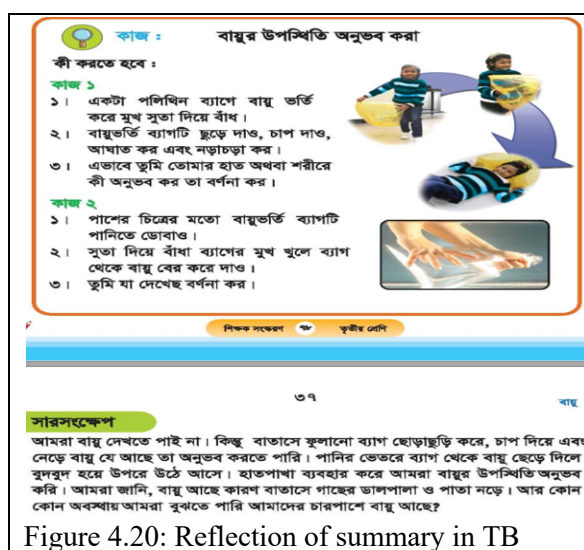


Figure 4.20: Reflection of summary in TB

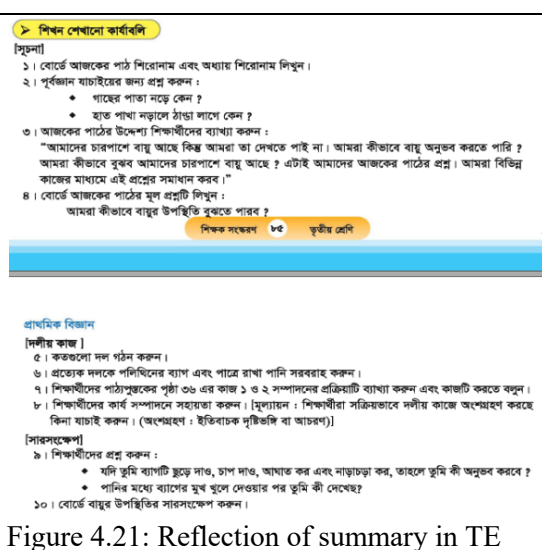


Figure 4.21: Reflection of summary in TE

The findings of lesson summary from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table 4.23.

Table 4.23: Summary of findings about lesson summary

Stakeholders	Stakeholders' comprehension about lesson summary			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of lesson summary	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lesson: 1	lessons-1: somewhat practiced	Somewhat addressed	Somewhat addressed
					Chapter:5 Lessons: 2&3		Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lessons: 4&5	lessons-2: somewhat practiced	Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Somewhat addressed	Somewhat addressed

The findings of table reveal that T1 and concerned stakeholders have somewhat comprehension of lesson summary. T1 somewhat focused lesson summary in the science classroom. The information of the lesson summary is somewhat addressed in TB and in TE.

➤ **Overall remark**

Teacher1's somewhat comprehension of the lesson summary was reflected in T1's classroom practice. Concerned stakeholders' somewhat comprehension may also be reflected in T1's comprehension and classroom practices. Though curriculum documents moderately provided the information of lesson summary it may not be reflected in T1 and concerned stakeholders' comprehension.

➤ **Overall remarks about the comprehension of the approaches of primary science textbooks and teacher's edition to facilitate inquiry-based teaching from case A**

The teacher has somewhat comprehension on most of the approaches of TB and TE. The teacher's somewhat comprehension was somewhat reflected in most of the approaches of TB and TE during classroom practices. Students also revealed that, teacher somewhat focuses most of the approaches of TB and TE in the science classroom. Concerned stakeholders' somewhat comprehension about most of the approaches of TB and TE; may be reflected in teacher's comprehension and classroom practices. Curriculum documents

(TB & TE) somewhat addressed most of the identified approaches, it may be somewhat reflected in T1 and concerned stakeholders' comprehension.

4.3 Learning Opportunities in Inquiry-based Teaching

The basic layout of textbooks follows the sequence of problem-solving approach and the learning activities of existing textbooks are aimed at the acquisition of science process skills necessary for learners to solve the problem (NCTB, 2022). It is also mentioned at the beginning of primary science textbooks as “Major features of the revised science textbooks” that introduce of a variety of experiments, demonstrations, observation and investigation activities to promote scientific attitude. However, scientific inquiry refers to the combining of traditional science processes with scientific knowledge, scientific reasoning and critical thinking to develop scientific knowledge as well as the development of science process skills (Venville & Dawson, 2004). Moreover, considering the importance of inquiry-based teaching-learning in science education, ‘National Science Education Standards’ of America proposed five essential features for inquiry-based teaching-learning (NRC, 2000, p. 24-27):

step-1. Learners are engaged by scientifically oriented questions

step-2. Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.

step-3. Learners formulate explanations from evidence to address scientifically oriented questions.

step-4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding

step-5. Learners communicate and justify proposed explanations

In this research the five essential features have been used to explore the given employed opportunities for the students in inquiry-based teaching.

The following section presents the results of document analysis, lesson observations, stakeholders' comprehension and FGD of students about the given opportunities for the students in inquiry-based teaching.

4.3.1 Step-1. Learners are engaged by scientifically oriented questions

The first essential features focus on a scientifically oriented question that precedes and drive the activity. In other words, the question provides the driving purpose for pursuing the investigation (NRC, 2000; p-24).

Teacher's classroom practices

It has been explored from the observed lessons that, after prior knowledge exploration or review of the previous lesson, the teacher started teaching learning activities. However, the teacher did not engage the students in scientifically oriented question. Table 4.24 shows the way of engaging students with a lesson by the teacher.

Table 4.24: Teacher 1's classroom practice about engaging students with scientifically oriented question

Grade & Chapter	ILO	Lessons in TE	Lesson taken by the teacher	Scientifically oriented question mentioned in TB and TE (Key Q.)	Teachers' activity in classroom
Grade-3, Chapter-5: 'Soil'	4.1.2	1	Lesson-1	What is soil made of?	After prior knowledge exploration, starting teaching learning activities with only three cups of sample soil material without focusing on the scientifically oriented question
	4.1.1	2 & 3		What are the differences between the three types of soil?	

Stakeholders' views

Engaging students with scientifically oriented question drive the investigation and allow students to explore, explain, extent and evaluate their progress (Cheesman, 2005; NRC, 2000). In the interview, stakeholders were asked about the importance of engaging students with scientifically oriented questions. In response to the question the teacher1 asserted that,

I always try to engage them with content related prior knowledge exploring question, so that they can understand what is going to read today and engage themselves into lessons; so, it is required for conducting lessons.

In the statement, T1 expressed prior knowledge exploring question as scientifically oriented question to engage students; that indicates T1's lack of understanding about the importance of inquiry-based teaching. Hence, the teacher1 did not comprehend about engaging students with scientifically oriented question.

Besides, stakeholders were asked about the provided information in TB and TE of engaging students by scientifically oriented question. Among them the AUEO1 said,

I do not see TE and TB that way and our work dimension is as much as we do not get chance to go through the science TB or TE completely. Where students cannot read Bangla and English, what will we do with science, so we do emphasis reading Bangla and English first then science.

The statement expresses the unawareness of AUEO1 about TB and TE, as AUEO1 explained differently to not follow TB and TE that way. Therefore, AUEO1 did not comprehend the information provided in TB and TE.

In addition, when asked about the way of engaging students in the lesson of science classrooms; among the stakeholders URC instructor1 replied,

Maximum time teacher conducts the class through textbook reading by the students; sometimes teacher explores students' prior knowledge through questioning that helps the teacher to engage the students with lesson.

In the statement, URCI1 mentioned prior knowledge exploring question for engaging students in science learning, which expresses URCI1's lack of understanding about inquiry-based learning. Hence, URCI1 did not comprehend the practice of engaging students in scientifically oriented question.

Students' response in FGD

The students' of FGD were asked about the way of engaging students in the lesson of science classrooms. Their common response was, usually their class starts with reading text from books. One of them stated

Teacher instructs us to read the textbook, one of us read and we all follow; sometimes teacher starts the lesson by singing a song or rhymes or some questions; we answer, if we can't then sir reply to us.

In the statement the student asserted that the teacher did not engage the students focus on key question to conduct a lesson.

Information provided in TB and TE

It is clearly stated as “Major Feature of the Revised Primary Science Textbooks” in the primary science textbooks of Bangladesh, that the key questions are highlighted as the core points of teaching learning in each lesson (NCTB, 2020). Analyzing the primary science textbooks and teacher’s editions, it is found that there is a focus on scientifically oriented question. The question is highlighted at the start of teaching learning activities of each lesson in TB (Figure 4.22). Whereas, it is placed after prior knowledge exploring question and lesson objectives related questions of teaching learning activities in TE (Figure 4.23).

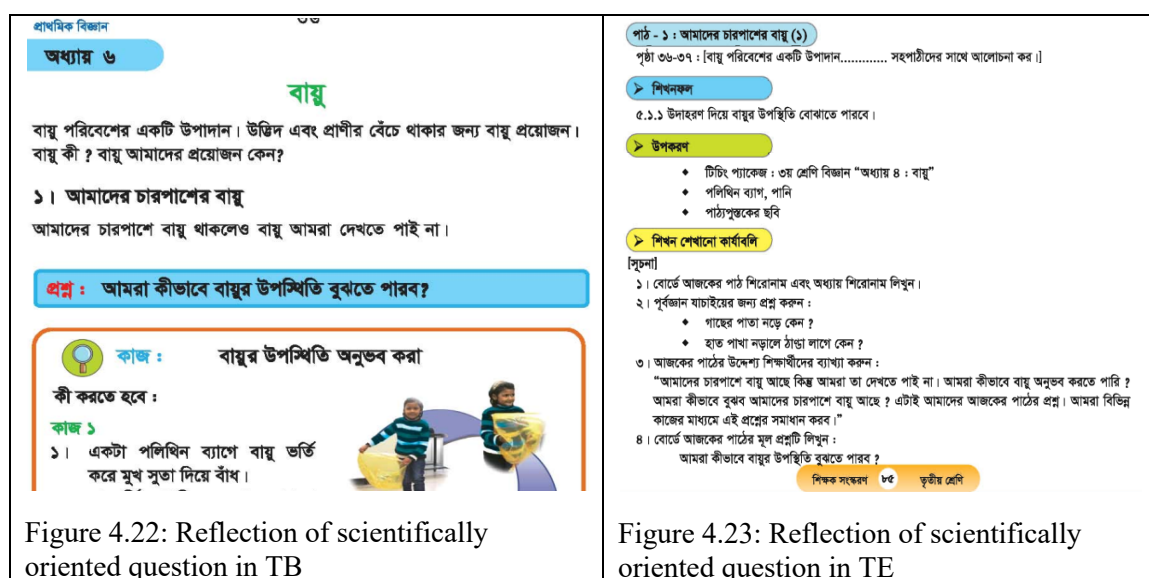


Figure 4.23: Reflection of scientifically oriented question in TE

The findings of engaging students by scientifically oriented questions from documents analysis (TB & TE), lesson observations and stakeholders’ comprehension are presented in the next table 4.25.

Table 4.25: Summary of findings about engaging students by scientifically oriented questions

Stakeholders	Stakeholders’ comprehension of engaging students’ by scientifically oriented questions			Overall comprehension	Chapter & lesson in Grade three	Teacher’s lesson practice	Information provided (Based on literature review)	
	Importance of engaging students	Given information in TE & TB	Way of engaging students				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lesson: 1	lessons-1: did not practice	Moderately addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lessons: 4&5	lessons-2: did not practice	Moderately addressed	Moderately addressed

Stakeholders	Stakeholders' comprehension of engaging students' by scientifically oriented questions			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of engaging students	Given information in TE & TB	Way of engaging students				In TB	In TE
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 1	lessons-3: did not practice	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 2	lessons-4: did not practice	Moderately addressed	Moderately addressed

The findings of the table reveal that, T1 and concerned stakeholders did not comprehend about engaging students with scientifically oriented questions. T1 did not engage students with scientifically oriented questions. The information is moderately addressed in TB and in TE.

➤ Overall remarks

Teacher1's comprehension of engaged students by scientifically oriented questions was reflected in T1's classroom practice. Concerned stakeholders' comprehension may also be reflected in T1's comprehension and classroom practices. Although the information is moderately addressed in curriculum documents; but did not reflect in T1 and concerned stakeholders' comprehension accordingly.

4.3.2 Step-2. Learners give priority to evidence in scientifically oriented questions

Learners collect and evaluate evidence, which allows them to develop and evaluate explanations that address the initial scientifically oriented question(s) (NRC, 2000, p. 24).

Teacher's classroom practice

It has been explored from the observed lessons of T1 that, T1 did not give students any opportunity to do the activities and collect data. An observed lesson of T1 is shown in table 4.26 where T1 did not form groups with students, has given a few samples for activity-1 and only 2/3 of students did the activity randomly. Therefore, students did not get the opportunity to collect data.

Table 4.26: Teacher 1's classroom practice about giving students priority to evidence in responding to the question

Grade & Chapter	LO	Lesson mentioned in TE	Classes are taken by the teacher	scopes mentioned in TB and TE	teachers' activity in classroom
Grade-3, Chapter-6: 'Air'	5.1.1	1	Class-3	-make groups -give sample in each group -give proper instruction and facilitate them	-did not form groups -done only activity-1 by 3-4 students randomly

Stakeholders' views

Stakeholders were asked, about giving students priority to evidence in responding to the question. AUEO1 said,

Usually, the teacher gives the answer first, then try to get an answer from the students; because students did not know the lesson earlier and can't give answer. For example, students do not know about soil so can't reply. The teacher first gives answers about soil properties and then tries to elicit answers from the students.

In the statement, it explores that AUEO1 have lack of knowledge of giving students priority to evidence in responding to the question. Actually, AUEO1 mentioned about prior knowledge exploring question and also explained the reason of the students' no reply. Hence, AUEO1 did not know about giving students priority to evidence in responding to the question.

Stakeholders were asked, about the information provided in TE and TB about giving students priority to evidence in responding to the question. URC instructor1 said,

There are opportunities to ask question to the students and give them time to answer in the TB and TE. After reading the text or doing the activities, provided in the TB and TE, students can reply Q-A, if they can't then the teacher gives the answer.

The statement expresses that, URCI1 did not comprehend about the information provided in TE and TB of giving students priority to evidence in responding to the question.

Stakeholders were asked, about the classroom practice of giving students priority to evidence in responding to the question. Teacher1 said,

The students do not know the lesson content earlier. So, they try to give the answer and I help them. For example, when I asked them the available plants name around your house. They all named different trees. Then, I told

them which is tree, which is shrub and which is herb, because they do not know the different characteristics of plant, they know all of them are trees. After that they will identify trees.

In the statement, T1 indicated prior knowledge exploring question which T1 practiced in the classroom that reveals that T1 did not know about the classroom practice of giving students priority to evidence in responding to the question.

Information provided in TB and TE

It is clearly stated as ‘Major Feature of the Revised Primary Science Textbooks’ to enhancement of learning activities in primary science that introduction of a variety of experiments, demonstration, observation and investigation to promote scientific attitude of the pupils (NCTB, 2020). Analyzing the primary science textbooks (TB) and teacher’s editions (TE) it is found that, there is scope for the students to collect evidence in responding to scientific question (Figure 4.24 & 4.25).

২। বিভিন্ন ধরনের মাটি

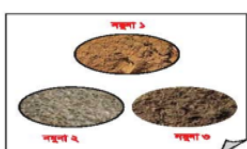
মাটি তিন ধরনের। এটেল মাটি, সোরাশ মাটি এবং বেলে মাটি।

প্রশ্ন: বিভিন্ন ধরনের মাটির মধ্যে পার্থক্য কী?

কাজ: বিভিন্ন ধরনের মাটির বৈশিষ্ট্য

কী করতে হবে:

- ১। নিচে দেখানো ছকের মতো তোমার বাতায় একটি ছক আঁক।
- ২। একটি খবরের কাগজ বিছিয়ে তার ওপর তিন ধরনের মাটি রাখ।
- ৩। তিন রকমের মাটি পর্যবেক্ষণ করে বৈশিষ্ট্যগুলো ছকে লেখ।
- ৪। তোমার কাজ নিয়ে সহপাঠীদের সাথে আলোচনা কর।



বৈশিষ্ট্য	নমুনা-১	নমুনা-২	নমুনা-৩
মাটির রং			
হাতে ধরলে অনুভূতি			
উপাদানসমূহের আকার			
অন্য কোনো বৈশিষ্ট্য			

Figure 4.24: Reflection of giving students priority in TB

৪। বোর্ডে আজকের পাঠের মূল প্রশ্নটি লিখুন:

বিভিন্ন ধরনের মাটির মধ্যে পার্থক্য কী?

দলীয় কাজ

- ৫। কতগুলো দল গঠন করুন।
- ৬। বোর্ডে পাঠ্যপুস্তকের পৃষ্ঠা ৩১ এর ছকটি আঁকুন এবং শিক্ষার্থীদের বাতায় ছকটি আঁকতে বলুন।
- ৭। প্রত্যেক দলকে কাগজের একটি শিট এবং তিন ধরনের মাটি (এটেল মাটি, বেলে মাটি এবং সোরাশ মাটি) সরবরাহ করুন।
- ৮। শিক্ষার্থীদের কার্য সম্পাদনের প্রক্রিয়াটি ব্যাখ্যা করুন।
- ৯। শিক্ষার্থীদের কাজটি করতে বলুন।
- ১০। শ্রেণিকক্ষ ঘুরে শিক্ষার্থীদের কার্য সম্পাদনে সহায়তা করুন। [মূল্যায়ন: শিক্ষার্থীরা পর্যবেক্ষণের মাধ্যমে তিন ধরনের মাটির বৈশিষ্ট্য চিহ্নিত করতে পেরেছে কিনা যাচাই করুন। (প্রক্রিয়াকরণ দক্ষতা: পর্যবেক্ষণ)]

সারসংক্ষেপ

- ১১। শিক্ষার্থীদের মতামত নিতে বলুন এবং বোর্ডে আঁকা ছকে সেগুলো লিখুন।
- ১২। বোর্ডে আজকের বিষয়বস্তুর (তিন ধরনের মাটির বৈশিষ্ট্য) সারসংক্ষেপ করুন।
- ১৩। প্রশ্ন করুন:

“তোমরা কি অনুমান করতে পার নমুনা ১, ২, এবং ৩ তিনটি মাটির মধ্যে কোনটি এটেল মাটি, বেলে মাটি এবং সোরাশ মাটি?” [মূল্যায়ন: শিক্ষার্থীরা তাদের কাজের কলাম্ব ও তিন ধরনের মাটির বৈশিষ্ট্যের মধ্যে তুলনা করে উত্তর প্রদান করেছে কিনা যাচাই করুন। (প্রক্রিয়াকরণ দক্ষতা: অনুমান/সিদ্ধান্ত গ্রহণ)]

শিক্ষক সংকলন ৭৪ কৃত্রিম প্রেই

Figure 4.25: Reflection of giving students priority in TE

A summary of the findings of document analysis, lesson observation and stakeholders’ comprehension of giving students priority to evidence in responding to the question are presented in table 4.27.

Table 4.27: Summary of findings about giving students priority to evidence in responding to the question.

Stakeholders	stakeholders' comprehension of giving students priority to evidence in responding to the question			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	About the importance of giving students priority	About the information provided in TE & TB	About the practice of giving student priority				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lesson: 1	lessons-1: somewhat practiced	Moderately addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Moderately addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:5 Lessons: 4&5	lessons-2: somewhat practiced	Moderately addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 1	lessons-3: somewhat practiced	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 2	lessons-4: somewhat practiced	Moderately addressed	Moderately addressed

The findings of table reveal that T1 did not comprehend about giving students priority to evidence in responding to the question. However, concerned stakeholders have somewhat comprehension; but one of them did not comprehend. T1 somewhat engages students in responding to the question. The information is somewhat addressed in TB and in TE.

➤ Overall remarks

The teacher did not comprehend about engaging students in responding to the question, and this was reflected in T1's classroom practice. The comprehension of concerned stakeholders may be reflected in the teacher's comprehension and classroom practices.

4.3.3 Step-3. Learners formulate explanations from evidence to address scientifically oriented questions

Teacher's classroom practice

It has been explored from the observed lessons that, the teacher did activities by own in front of the class. Students did not get the opportunity to see or do the activity by their own. As a result, they could not collect data to make explanation from the evidence. Table 4.28, shows the teacher's classroom practice to formulate explanation from the evidence by the students.

Table 4.28: Teacher 1's classroom practice to formulate explanations from evidence by the students

Grade & Chapter	LO	Lessons mentioned in TE	Lessons are taken by the teacher	The scope mentioned in TB & TE to formulate explanations from evidence	Teachers' activity in classroom
Grade-3, Chapter-5: 'Soil'	4.1.3	4 & 5	Lesson-2	instruct the students to record the data in their notebooks after observing the activity	fill up the chart by own on board

Stakeholders' views

Forming explanations is the way an individual learns about something unfamiliar or unknown by relating the evidence they gather to what they already know (NRC, 2000). Stakeholders were asked, to formulate explanations from evidence from the students. PTI instructor1 said,

Usually, students can't explain the answer that way. The lesson is new for them, they only can reply to the Q-A in the way the teacher teaches them. So, teacher does not ask them about the explanation.

The statement reveals the unawareness of PTII1 about the formulation of explanations from evidence by the students, as PTII1 stated the reason is new lesson for the students. However, formulation of explanation occurs by relating the evidence the students gather to what they already know. Hence, PTII1 does not comprehend the inquiry step.

Stakeholders were asked, about the information provided in TE and TB to formulate explanations from evidence by the students. AUEO1 said,

I did not notice it that way, actually our teacher tries to follow TB and TE but they have limitations, so can't follow properly.

Analyzing the primary science TB and TE there found scopes for students to formulate explanations from evidence. Therefore, AUEO1 did not comprehend the information provided the documents.

According to NRC (2000), Forming explanations is the way an individual learns about something unfamiliar or unknown by relating the evidence they gather to what they already know. Stakeholders were asked, about the classroom practice of formulating explanations from evidence by the students. The teacher1 said,

Most of the time students cannot give an explanation of their answer from evidence as they do not know about the lesson earlier and cannot link the topic with the activity. They only say about the experiment that they have seen around them and I try to explain the answer. For example, which soil contains much water? They can reply but cannot explain the reason because they do not know about soil characteristics that way.

In the statement, T1 stated the reason students for not being able to explain from the evidence as students have no previous idea about the lesson. Therefore, T1 does not comprehend the classroom practice of formulating explanation.

Information provided in TB and TE

It is clearly stated as “Major Feature of the Revised Primary Science Textbooks” in the primary science textbooks of Bangladesh that, introduction of a variety of experiments, demonstration, observation and investigation to promote scientific attitude of the pupils (NCTB, 2020); that approach helps students to formulate explanation of scientific question. Analyzing the primary science textbooks (TB) and teacher’s editions (TE), it is found that there is an opportunity for the students to formulate explanation of the scientific question through activity (Figure 4.26 & 4.27).

কাজ : মাটির পানি ধরে রাখার ক্ষমতা

কী করতে হবে :

- ১। এটেল মাটি, বেলে মাটি এবং দোআঁশ মাটি সংগ্রহ কর।
- ২। নিচে দেখানো ছকের মতো একটি ছক তৈরি কর।
- ৩। শিক্ষকের সাহায্য নিয়ে পেট বোতল কেটে তিনটি ফানেল বানাও।
- ৪। ডানে দেখানো চিত্রের মতো একই পরিমাণে তিন রকমের মাটি তিনটি ফানেলে রাখ এবং জগ থেকে একই পরিমাণের পানি তিনটি ফানেলে ধীরে ধীরে ঢাল।
- ৫। কোন ফানেলের পানি তাড়াতাড়ি পড়ছে, কোন পাত্রে পানি বেশি পরিমাণে জমা হয়েছে তা লক্ষ কর।
- ৬। জুমি যা দেখেছ তা ছকে লিপিবদ্ধ কর।
- ৭। তোমার কাজ নিয়ে সহপাঠীদের সাথে আলোচনা কর।

	এটেল মাটি	বেলে মাটি	দোআঁশ মাটি
কত তাড়াতাড়ি পানি পাত্রে পড়ছে			
পাত্রে জমা পানির পরিমাণ			

সতর্কতা : বোতলের ধারগুলো লেগে তোমার হাত যেন না কাটে।

চিন্তা কর এবং আলোচনা কর

- কোন মাটি বেশি পরিমাণ পানি ধরে রাখতে পারে?
- জুমি কেন এমনটি মনে কর?

Figure 4.26: Reflection of scope of formulate explanation in TB

দিলীয় কাজ :

- ৫। কতগুলো দল গঠন করুন।
- ৬। বোর্ডে পরীক্ষকের পৃষ্ঠা ৩৩ এর ছকটি আঁকুন এবং শিক্ষার্থীদের বাতায় ছকটি আঁকতে বদুন।
- ৭। প্রতিটি দলকে তিন রকমের মাটি (এটেল মাটি, বেলে মাটি এবং দোআঁশ মাটি), তিনটি পেট বোতলের ফানেল এবং তিনটি গ্লাস সরবরাহ করুন।
- ৮। শিক্ষার্থীদের কার্য সম্পাদনের প্রক্রিয়াটি ব্যাখ্যা করুন। (দ্রষ্টব্য : শিক্ষক অবশ্যই নির্দেশনা প্রদান করুন যে, “পেট বোতলের ফানেল ব্যবহারে সতর্ক থাকবে কারণ এর ধার/প্রান্ত খুব ধারালো। পরীক্ষণ আরোজনের সময়ে এটির প্রান্ত স্পর্শ করবে না।)
- ৯। শিক্ষার্থীদের কাজটি করতে বদুন।
- ১০। প্রেক্ষিতক যুগে শিক্ষার্থীদের কাজ পর্যবেক্ষণ করুন ও প্রয়োজনে সহায়তা করুন। (মূল্যায়ন : শিক্ষার্থীরা পর্যবেক্ষণের মাধ্যমে ছকে তথ্য সংরক্ষণ করেছে কিনা যাচাই করুন। (প্রক্রিয়াকরণ দক্ষতা : পর্যবেক্ষণ ও পরিমাপ))

শিক্ষক সংস্করণ ৭৬ তৃতীয় প্রেসি

মাত্রা

সারসংক্ষেপ

১১। শিক্ষার্থীদের মতামত দিতে বদুন এবং বোর্ডে আঁকা ছকে সেগুলো লিখুন।

Figure 4.27: Reflection of scope of formulate explanation in TE

Table 4.29 presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of formulating explanation.

Table 4.29: Summary of findings about formulating explanation from evidence by the students.

Stakeholders	stakeholders' comprehension of formulating explanation from evidence by the students.			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	About formulating explanation from evidence	About the information provided in TE & TB	About the practice of formulating explanation in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lesson: 1	lessons-1: did not practice	Moderately addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lessons: 4&5	lessons-2: did not practice	Moderately addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 1	lessons-3: did not practice	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 2	lessons-4: did not practice	Moderately addressed	Moderately addressed

The findings of the table reveal that T1 and concerned stakeholders did not comprehend about formulating explanation from evidence by the students. T1 did not engage students to formulate explanation from evidence. The information is moderately addressed in TB and in TE.

➤ Overall remarks

The teacher did not comprehend of formulating explanation from evidence by the students; and this was reflected in T1's classroom practice. The comprehension of concerned stakeholders may be reflected in the teacher's comprehension and classroom practices.

4.3.4 step-4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting scientific understanding

Learners review alternative explanations as they engage in dialogues with each other, compare results, or check their results with those proposed by the teacher, other experts, or instructional materials. Through the process of evaluation, an explanation that is commonly agreed upon by all learners emerges. Learners connect their results to the scientific knowledge appropriate to their level of development. Thus, learners should reach conclusions that are-consistent with currently accepted scientific knowledge (NRC, 2000).

Teacher's classroom practice

It has been explored from the observed lessons that, after doing the activity by own self, the teacher explains the activity; filled the provided blank table on the board by own self, and directs the students to read their books. A lesson exercise of T1 is shown in Table 4.30.

Table 4.30: Teacher 1's classroom practice about giving learners opportunity to evaluate their explanations in light of alternative explanation

Grade & Chapter	LO	Lessons mentioned in TE	Lessons are taken by the teacher	Scope mentioned in TB to evaluate explanations in light of alternative explanations	Scope mentioned in TE to evaluate explanations in light of alternative explanations	Teachers' activity in classroom
Grade-3, Chapter-5: 'Soil'	4.1.3	4 & 5	Lesson-2	Fill up the table and discuss with your classmates	Fill up the table on board according to students answer and summarize the content	filled the chart on the board by own self

Stakeholders' views

Learners review alternative explanations as they engage in dialogues with each other, compare results, or check their results with those proposed by the teacher, other experts, or instructional materials (NRC, 2000). To know about this, stakeholders were asked, about providing students the opportunity to evaluate their explanations in light of alternative explanations. Teacher1 said,

To evaluate students' answer I receive random answer from students then reply the correct answer first and finally told them to see text book's content.

The statement reveals T1's lack of understanding as T1 reply the correct answer before giving students the opportunity to check their answer from textbooks on own. T1 did not comprehend giving students the opportunity to evaluate their explanations in light of alternative explanations.

Stakeholders were asked, about the information providing students opportunity to evaluate their explanations in light of alternative explanations. AUEO1 said,

I did not notice it that way, actually our teacher tries to follow TB and TE but they have limitations, so can't follow properly.

The statement explores AUEO1's unawareness of the given information in TB and TE. Hence, AUEO1 did not comprehend about the information providing students opportunity to evaluate their explanations in light of alternative explanations.

Stakeholders were asked, about the classroom practice of giving opportunity to evaluate their explanations in light of alternative explanations. URC instructor1 said,

Teachers do not practice it in classroom. They ask question to the students, 2-3 students can reply or not, only reading text is the main focus. Teacher has to answer them correctly, so that they can give the answer.

The statement explores that URCI1 has no idea about giving opportunity to evaluate students' explanations in light of alternative explanations as URCI1 stated, the teacher has to give the right answer. Hence, URCI1 did not comprehend the steps of inquiry.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is given opportunities for the students to evaluate students' explanation in light of alternative explanation (Figure 4.28 & 4.29).

৩১

২। বিভিন্ন ধরনের মাটি
মাটি তিন ধরনের। এটেল মাটি, সোআঁশ মাটি এবং বেলে মাটি।

এবং : বিভিন্ন ধরনের মাটির মধ্যে পার্থক্য কী?

কাজ : বিভিন্ন ধরনের মাটির বৈশিষ্ট্য

কী করতে হবে :

- ১। নিচে দেখানো ছকের মতো তোমার খাতার একটি ছক আঁক।
- ২। একটা খবরের কাগজ বিছিয়ে তার ওপর তিন ধরনের মাটি রাখ।
- ৩। তিন রকমের মাটি পর্যবেক্ষণ করে বৈশিষ্ট্যগুলো ছকে লেখ।
- ৪। তোমার কাজ নিয়ে সহপাঠীদের সাথে আলোচনা কর।



বৈশিষ্ট্য	নমুনা-১	নমুনা-২	নমুনা-৩
মাটির রং			
হাতের খসে অস্বস্তি			
উপাদানসমূহের আকার			
অন্য কোনো বৈশিষ্ট্য			

Figure 4.28: Reflection of opportunity to evaluate students' explanation in TB

[সারসংক্ষেপ]

- ১১। শিক্ষার্থীদের মতামত দিতে বদুন এবং বোর্ডে আঁকা ছকে সেতুলো লিখুন।
- ১২। বোর্ডে আজকের বিষয়বস্তুর (তিন ধরনের মাটির বৈশিষ্ট্য) সারসংক্ষেপ করুন।
- ১৩। গ্রন্থ করুন;

"তোমরা কি অনুমান করতে পার নমুনা ১, ২, এবং ৩ তিনটি মাটির মধ্যে কোনটি এটেল মাটি, বেলে মাটি এবং সোআঁশ মাটি?" [মূল্যায়ন : শিক্ষার্থীরা তাদের কাজের ফলাফল ও তিন ধরনের মাটির বৈশিষ্ট্যের মধ্যে তুলনা করে উত্তর প্রদান করছে কিনা যাচাই করুন। (প্রক্রিয়াকরণ দক্ষতা : অনুমান/সিদ্ধান্ত গ্রহণ)]

শিক্ষক সংস্করণ ৭৪ তৃতীয় প্রেসি

মাটি

- ১৪। বোর্ডে পাঠ্যপুস্তকের পৃষ্ঠা ৩২ এর ছকটি আঁকুন এবং শিক্ষার্থীদের খাতায় ছকটি আঁকতে বদুন।
- ১৫। দলীয় আলোচনার প্রক্রিয়াটি বর্ণনা করুন।
- ১৬। শিক্ষার্থীদের আলোচনা করতে বদুন।
- ১৭। শিক্ষক প্রদত্ত যুগে দলীয় কাজ পর্যবেক্ষণ করবেন এবং প্রয়োজনে সহায়তা করবেন। [মূল্যায়ন : শিক্ষার্থীরা ভাবে দলীয় আলোচনায় মত প্রকাশ করছে কিনা যাচাই করুন। (অংশগ্রহণ : ইতিবাচক দৃষ্টিভঙ্গি বা আচরণ)]
- ১৮। শিক্ষার্থীদের মতামত দিতে বদুন এবং বোর্ডে আঁকা ছকে সেতুলো লিখুন।
- ১৯। বোর্ডে দলীয় আলোচনার সারসংক্ষেপ করুন।
- ২০। শিক্ষার্থীদের খাতায় আজকের পাঠের সারসংক্ষেপ লিখতে বদুন।
- ২১। শিক্ষার্থীরা খাতায় লিখে কিনা যাচাই করুন।
- ২২। শিক্ষার্থীদের ধন্যবাদ দিয়ে আজকের পাঠ শেষ করুন।

Figure 4.29: Reflection of opportunity to evaluate students' explanation in TE

Table 4.31 presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of giving opportunity to evaluate students' explanations in light of alternative explanations.

Table 4.31: Summary of findings about giving opportunity to evaluate students' explanations in light of alternative explanations.

Stakeholders	Stakeholders' comprehension of giving students opportunity to evaluate their explanation			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	About formulating explanation from evidence	About the information provided in TE & TB	About the practice of giving students opportunity to evaluate				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lesson: 1	lessons-1: did not practice	Moderately addressed	Moderately addressed
					Chapter:5 Lessons: 2&3		Moderately addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lessons: 4&5	lessons-2: did not practice	Moderately addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 1	lessons-3: did not practice	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 2	lessons-4: did not practice	Moderately addressed	Moderately addressed

The findings of table reveal that T1 and concerned stakeholders did not comprehend about giving opportunity to evaluate students' explanations in light of alternative explanations. T1 did not give opportunity to evaluate students' explanations in light of alternative explanations. The information is moderately addressed in TB and TE.

➤ Overall remarks

The teacher did not comprehend about giving opportunity to evaluate students' explanations in light of alternative explanations, and this was reflected in T1's classroom practice. Concerned stakeholders also did not comprehend and this may be reflected in the teacher's comprehension and classroom practices.

4.3.5 Step-5. Learners communicate and justify proposed explanations

Lastly, the fifth essential feature is that learners communicate and justify their proposed explanations. By sharing their explanations, students eventually become more confident with their conclusions (NRC, 2000).

Teacher's classroom practice

It has been explored from the observed lessons that, after explaining the activity and filled the provided blank table on the board by own self, T1 directs the students to read their books. However, T1 did not form groups or directs the student' to form groups for group discussion. Therefore, students do not have the opportunity to communicate with each other and justify the explanation. A lesson exercise of T1 is shown in Table 4.32.

Table 4.32: Teacher 1's classroom practice about learners communicating and justifying their proposed explanation

Grade & Chapter	LO	Lessons mentioned in TE	Lessons are taken by the teacher	Scope mentioned in TB to communicate with others and justify students' explanation	Scope mentioned in TE to communicate with others and justify students' explanation	Teachers' activity in classroom
Grade-3, Chapter-5: 'Soil'	4.1.3	4 & 5	Lesson-2	group discussion	-group discussion, -filled the table by students' group discussion answer	did not form group

Stakeholder' views

In having students share their explanations, others can-ask questions, examine evidence, identify faulty reasoning, point out statements that go beyond the evidence, and suggest alternative explanations (NRC, 2000, p. 24-27). Stakeholders were asked about students' communication with each other's and justified their explanations. AUEO1 said,

Our students are more in number in a class; the teacher focuses TB content, reading the text by the students; asking them questions and instructing them to follow the book and others' answers so that they can memorize the lesson.

The statement explores that, AUEO1 has given explanations about learners evaluating their explanations in light of alternative explanations to memorize the lesson; that reveals AUEO1 did not comprehend.

Stakeholders were asked about the information provided in TE and TB about students' communication with each other's and justify their explanations. Teacher1 said,

I did not find that type of any instruction in TB and do not follow TE that way, actually I do not get enough time to follow TE instructions.

The statement explores that, T1 was unaware about curriculum documents and T1 did not comprehend the approaches of inquiry.

Stakeholders were asked about the classroom practice of students' communication with each other's and justify their explanations. Teacher1 said,

Actually, I told students to follow other's answer if she/he reply wrong answer, then directs to read the book and match the answer with TB content, they can't give their justification that way, so I receive answer from several students so that they can memorize it.

The statement reveals that T1 did not comprehend about classroom practice of students' communication with each other's and justify their explanations.

Information provided in TB and TE:

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there are given opportunities for the students to communicate with others and justify their explanation through group discussion (Figure 4.30 and 4.31).

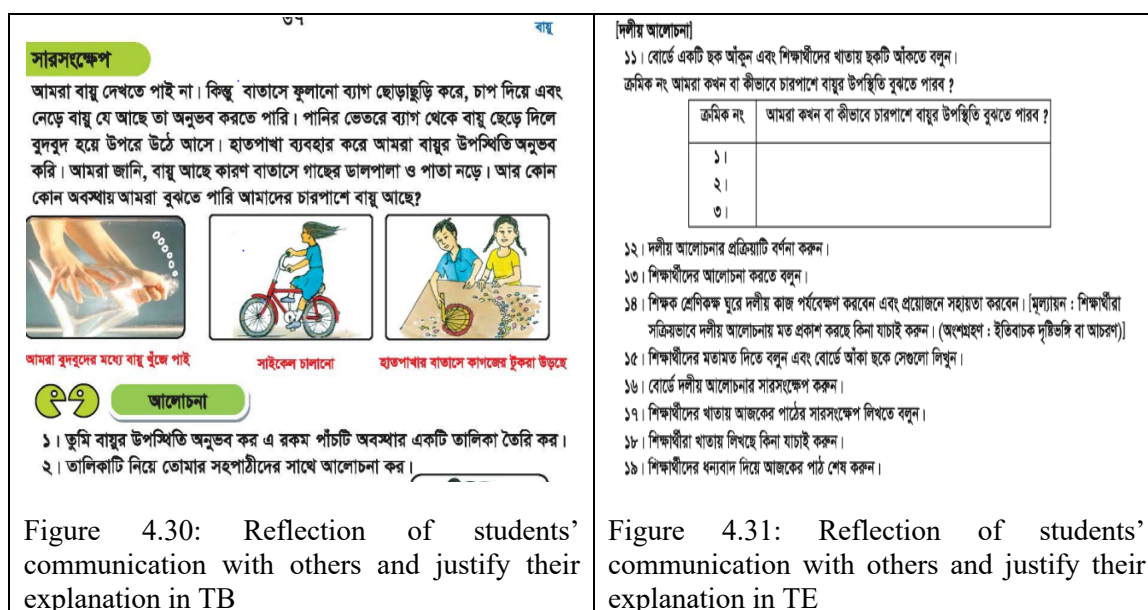


Figure 4.30: Reflection of students' communication with others and justify their explanation in TB

Figure 4.31: Reflection of students' communication with others and justify their explanation in TE

A summary of the findings of document analysis, lesson observation and stakeholders' comprehension about opportunities for the students to communicate with others and justify their explanation through group discussion are presented in table 4.33.

Table 4.33: Summary of findings about learners communicating and justified their proposed explanations

Stakeholders	Participants view about students' communication with each other's and justify their explanations			Overall comprehension	Chapter & lesson in Grade three	Teacher's lesson practice	Information provided (Based on literature review)	
	About evaluate their explanations	About the information provided in TE & TB	About the practice of evaluate their explanations				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lesson: 1	lessons-1: did not practice	Somewhat addressed	Somewhat addressed
					Chapter:5 Lessons: 2&3		Somewhat addressed	Somewhat addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:5 Lessons: 4&5	lessons-2: did not practice	Somewhat addressed	Somewhat addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 1	lessons-3: did not practice	Somewhat addressed	Somewhat addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson: 2	lessons-4: did not practice	Somewhat addressed	Somewhat addressed

The findings of table reveal that, T1 and concerned stakeholders did not comprehend about learners' communication with each other's and justify their explanations. T1 did not give opportunity to learners' communication with each other's and justify their explanations. The information is somewhat addressed in TB and TE.

➤ Overall remarks

Teacher1's comprehension of giving opportunity to learners' communication with each other's and justify their explanations was reflected in T1's classroom practice. Concerned stakeholders' comprehension may also be reflected in the teacher's comprehension and classroom practices.

➤ Overall remarks on given learning opportunities provided for inquiry-based teaching from case A

The teacher 1 did not comprehend inquiry approaches. The teacher's comprehension of inquiry was reflected in the classroom as teachers did not practice inquiry-based teaching in the science classroom. Students also revealed that teachers did not focus on inquiry approaches in the science classroom. Concerned stakeholders did not comprehend the inquiry approaches that may be reflected in teachers' comprehension and classroom practices. Curriculum documents (TB & TE) mostly addressed moderately about the inquiry approaches.

4.4 Comprehension of Practiced Assessment Methods (formative and summative) to Assess ILOs

According to Biggs (2003), assessment has two significant purposes: emphasize on quality of learning, and outlines what is to be learned by the students (Intended curriculum). The assessment carried out in school are two types: formative (assessment for learning) and summative (assessment of learning); both are interconnected (Lau, 2016) and interdependent (Houston & Thompson, 2017).

The following section presents the results of the comprehension of practiced assessment methods: summative and formative, through documents analysis, lesson observation and interviews.

4.4.1 Formative assessment: areas and tools

Assessment must allow students to reveal the area of their knowledge and skills according to the expectations of the curriculum frameworks (La Marca, 2001). There is an instruction at the beginning of the primary science teacher's edition about assessment that, "give more emphasize on students content knowledge, science process skills and scientific attitude during assessment". There is also instruction to select necessary methods and tools before conducting the lesson, in accordance with the achievement of intended learning outcome (NCTB, 2020).

Provided information in Text Books (TB), Teacher's Edition (TE) and Assessment Guide (AG)

It is clearly instructed at the start of the teacher's edition that, "conduct formative assessment of the student during and end of the lesson, and keep record according to assessment guide". However, the following table 4.34, presents the data from documents analysis and lesson observations of assessment areas (cognitive knowledge, science process skills; scientific attitude and values) and assessment tools (Oral and written). Analyzing the primary science textbooks (TB), teacher's editions (TE) and assessment guide (AG) it is found that, the information provided for lesson-2 & 3, extremely addressed in TE following AG instruction but did not address in TB that way.

Table 4.34: Information provided for formative assessment areas and assessment tools in grade-3; chapter-soil; ILO no-4.1.2, 4.1.1; Lessons-2 &3.

Selected assessment areas, sub-areas and tools in Assessment Guide			Assessment focused at TE		Assessment focused at TB		Assessment practiced by the teacher		
areas	sub-areas	tools	Assessment areas	Assessment tools	Assessment areas	Assessment tools	Assessment areas	Assessment tools	
cognitive Knowledge	remembering	oral assessment checklist	knowledge	questions	knowledge	questions	knowledge	oral questions	
	understand								
	application	written questions							
	higher order learning								
science process skills	observation	observation checklist	observation	Verify students' classwork					
	measurement	oral checklist							
	classification		prediction	Verify students' answer					
	prediction								
	decision making								written questions
	experiment								
communication									
scientific attitude and values	interest	observation checklist	positive attitude	Verify students' active participation in group discussion					positive attitude
	curiosity								
	open mindedness								
	curious on verification								

Teacher's classroom practice

The table reflects that T1 focused only on knowledge for assessment through oral questions in the lessons 2 & 3. T1 did not focus on any scientific skills and attitude, and did not focus on any other tools which are also mentioned in TE. Therefore, T1 somewhat practiced the mentioned assessment areas and tools.

Stakeholder' views about formative assessment method: areas and tools

At the beginning of teacher's edition, there is an instruction for the teachers to determine assessment methods and tools for assessing the achieved ILO so that students' competency can be assessed and possible necessary steps can be taken during formative assessment (NCTB, 2020).

Formative assessment areas

According to Lok et al. (2016), one of the main principles of assessment is to grade students with different levels of knowledge and skills. The primary science teacher's edition provides guidance for the teachers, to give special emphasis on students' content knowledge, science process skills, and scientific attitude during the assessment. Here,

stakeholders were asked about the focus areas of formative assessment during classroom assessment. The PTI instructor1 said,

The classroom assessment focus is learning outcome. knowledge, application and affective domain come in different lesson wherever it is needed as assessment areas, these areas may not be focused in all the lessons for assessment, these are in TE.

In the statement, PTII stated the focus areas for of formative assessment where skill is totally absent as a learning assessment focus. This statement indicated that PTII1 has somewhat comprehension of the focus areas of formative assessment.

Emphasize has been given in science teaching learning activities to enhance scientific knowledge, science process skills and scientific attitude that was mentioned in the beginning of science textbooks as 'Major feature' (NCTB, 2020). To know stakeholders' knowledge about the information provided in documents, they were asked about the scopes of assessment areas on given activities in TE and TB with examples. Teacher1 said,

Actually, we have to do many works along with our classes and have classes of different subjects. So, we couldn't concentrate on each subject in TB and TE deeply. Actually, I try to follow TB but so far, I noticed TE, I could not understand.

The explanation reveals T1's unawareness about the information provided in the documents, as T1 did not follow TE and TB, and did not understand that way.

The primary science teacher's edition directs teachers to conduct formative assessments during and at the end of lessons focusing on the assessment areas: science knowledge, science process skills and scientific attitude, and to keep assessment records as per the assessment guide (NCTB, 2020). Therefore, stakeholders were asked about teacher's classroom practice of formative assessment areas. AUEO1 said,

Most of the teacher remains restricted in students' knowledge level, they can't focus in understand and application level. Most of the students could not read, so the teacher did not get interested to assess them focusing on different areas.

In the explanation above, among the assessment focus areas mentioned in the teacher's edition and the assessment guide, AUEO1 mentions only knowledge. The important two

other assessment areas of science learning are absent in the statement, which reveals that AUEO1 has somewhat comprehension about the assessment focus areas.

Formative assessment tools

The primary science teacher's edition recommends teachers complete formative assessments using methods and tools according to the assessment guide (AG). Here, stakeholders were asked about the scope of assessment tools in the provided activities of TE and TB. The teacher1 said,

Actually, I become so busy with my class and other school-based activities that I could not get chance to see the TE and TB that way, but I follow TB for classroom assessment.

Here, the unawareness of T1 is explored in the above statement, as T1 only follows TB for classroom assessment. However, guidelines for classroom assessment are clearly provided in TE and AG. Hence, T1 has somewhat comprehension of classroom assessment tools.

According to the instructions of AG, the teacher will assess the students using one or more processes such as oral, written, and observation, as per ILO during conducting lessons (NCTB, 2020). Additionally, teachers can effectively assess students by following textbooks and teacher's editions in addition to the assessment guide. Hence, stakeholders were asked about the assessment tools practice in the classroom. URC instructor1 said,

There are two processes for classroom assessment: oral and written, teachers usually use oral questions for assessment and rarely use written questions. They did not fully assess the students; only the chosen 2 or 3 can answer and the teacher considers the assessment complete.

The statement reveals that URCI1 mentioned oral and written processes for classroom assessment; whereas according to AG, observation is a very much important assessment tool for assessing scientific attitudes in science teaching learning activities. Therefore, URCI1 has somewhat comprehension of the classroom assessment process.

A summary finding of stakeholders' comprehension of formative assessment method is presented in table 4.35 next.

Table 4.35: Stakeholders' comprehension of formative assessment methods

Stakeholders' comprehension about formative assessment: areas and tools						Overall comprehension of formative assessment areas and tools
Stakeholders	Areas of formative assessment	Information of formative assessment areas in TB & TE	Views about classroom practice of assessment areas	Information of formative assessment tools in TB & TE	Views about classroom practice of assessment tools	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table reveals that the teacher and concerned stakeholders have somewhat comprehension of the areas and tools of formative assessment. However, they also have somewhat comprehension of TB and TE provided information. Moreover, teacher and concerned stakeholders have somewhat comprehension of classroom practice of formative assessment areas and tools.

The summary of findings about the information provided in TB and TE; and level of T1's practiced assessment methods in the classroom and stakeholders' views are shown in table 4.36.

Table 4.36: Summary of findings about formative assessment methods

Stakeholders	Stakeholders' comprehension of formative assessment methods			Overall comprehension of assessment methods	Chapter, Lesson & No. of ILO in Grade three	Teacher's lesson practice	Information provided (Based on literature Review)		
	About areas of formative assessment	About given Information in TB & TE	About way of classroom assessment				In TB	In TE	In AG
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 5 Lesson: 1	Not practice	Somewhat addressed	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 5 Lessons: 2&3	Lesson-1: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 5 Lessons: 4&5	Lesson-2: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	Lesson-3: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
					Chapter: 6 Lesson: 2	Lesson-4: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed

The table reflects that teacher and concerned stakeholders have somewhat comprehension of formative assessment methods. It also explores that, T1 somewhat practiced formative assessment, as T1 did not focus on assessment areas and did not practice assessment tools

as such in the classroom. The information on formative assessment areas and assessment tools are somewhat addressed in AG, TB, and TE.

➤ **Overall remarks**

The teacher has somewhat comprehension of formative assessment methods and this was reflected in T1's classroom practice. Concerned stakeholders also have somewhat comprehension and this may be reflected in the teacher's comprehension and classroom practices. Curriculum documents are addressed somewhat and this may also be reflected in teacher and concerned stakeholders' comprehension and the teacher's classroom practice.

4.4.2 Summative assessment: areas and tools

Summative assessment is considered a good indication to know the taken learning and the students' achievement at a given point in time (Gardner & Gardner, 2012). According to Houston and Thompson (2017), summative assessment is a way of generating information and judgments by applying the tools and methods.

Stakeholder' views of summative assessment

Only subject knowledge is considered an area for summative assessment in primary science subjects and assessment of students' subject knowledge will be based on four types of learning outcomes or learning areas: remembering, understanding, applying and higher order learning (AG). To know the stakeholders' view they were asked about the areas of summative assessment. Teacher1 said,

I do not prepare questions, usually experienced master trainers do it centrally in groups in Upazila, the focusing areas of summative assessment are knowledge, understand, application. I do assess the exam sheets following the areas and number mentioned in the question, for example- type of soil is knowledge, which plants grow in which soil is understand.

The statement reveals that T1 did not get the opportunity to develop summative assessment questions just follow the provided instruction. Therefore, T1 has somewhat comprehension of the areas of summative assessment.

In response to a question asked about the instructions given in the documents (TE, TB & AG) specifying the areas of summative assessment, URC instructor1 replied,

There are questions in the end of each chapter in TB and TE; but no other instruction was provided regarding summative assessment, the teachers follow the marking skim provided by NCTB to assess the answer script.

In the statement, it reveals that URCI1 was unaware of the assessment instruction and has no idea about the assessment guide. URCI1 also stated marking skim for assessment instruction. URCI1 did not know the instruction provided in documents for summative assessment.

Stakeholders were asked about the development of summative assessment questions. AUEO1 replied,

Upazila forms a committee with the expert person to prepare questions centrally; they follow the marking skim provided by NAPE; then the question disseminates in all the schools of the Upazila. The teacher assesses the answer sheet following marking skim or sometimes we instruct them to prepare their own marking skim following NAPE.

In the statement, it reveals that only a few selective expert persons are involved in developing summative assessment questions. AUEO1 did not engage in developing questions but had some knowledge about the development of summative assessment questions.

A summary finding of stakeholders' comprehension of the summative assessment method is presented in the next table 4.37 where areas of assessment, the information provided in documents and the development process of assessment questions are included.

Table 4.37: Stakeholders' comprehension of summative assessment method

Stakeholders' comprehension about summative assessment method				Overall comprehension
Participants	Focusing areas of assessment	Information provided at documents about assessment areas	Development of summative assessment question	
Teacher	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table 4.37 reveals that the teacher and concerned stakeholders have moderate comprehension about the focusing areas of summative assessment. Moreover, they have somewhat comprehension of the provided information in the documents and question development. Therefore, the stakeholders have somewhat comprehension of summative assessment method.

Practiced summative assessment question in the school

The collected summative assessment question is analyzed focusing on areas and tools, and the findings are presented in table 4.38 next.

Table 4.38: Areas and tools of the practiced summative assessment

Types of questions	Cognitive knowledge								Total no of Q.	Total number of different Q.
	Remembering		Understanding		Applying		Higher order learning			
	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.		
Short Q.	2	2×2=4	3	3×2=6	7	7×2=14	-	-	12	24
Fill in the blanks	12	12×1=12	-	-	-	-	-	-	12	12
Matching	5	5×2=10	-	-	-	-	-	-	5	10
Narrative Q.	5 ½×2 1/3×2	5×10=50 2×4=8 2×2=4	-	-	1/2×2	2×6=12	1/3×1	1×6=6	8	80
Total	-	88 (69.84%)	-	6 (4.761%)	-	26 (20.63%)	-	6 (4.67%)	37	126

The table 4.38 reveals that the practiced summative assessment question covered a maximum of almost 70% (69.84) of questions focusing on remembering whereas, higher order thinking covered only almost 5% (4.67). There are found an anomaly in the question, where 5 questions within 37 were repeated. However, there is no marks distribution for a fraction of questions in the narrative part, which can confuse teachers to mark against each question.

The findings of the analyzed summative assessment question and the information provided by NCTB and the assessment guide (AG) for preparing summative assessment questions are presented in the next table 4.39.

Table 4.39: Provided areas and percentage of summative assessment questions

Areas and percentage of knowledge for summative assessment			
Areas of knowledge	% of practiced questions	proposed % from NCTB	Proposed % from assessment guide
remembering	69.84	20	30
understanding	4.76	30	30
applying	20.63	30	30
HOT	4.67	20	10

In the table 4.39 it explores that the maximum % (69.84) question was from remembering and the minimum % (4.67) question was from higher order thinking (HOT) in practiced summative question. However, there is a big gap in remembering (69.84%) and understanding (4.76%) areas in the analyzed question. NCTB suggested 20% and assessment guide (AG) suggested 30% of questions from remembering. In the case of understanding, both NCTB and AG suggested 30 % questions. Therefore, the practiced summative question did not follow the provided instructions for preparing questions.

➤ Overall remarks

The teacher and concerned stakeholders did not have the opportunity to be involved in the summative assessment question development. However, they were somewhat comprehend of the summative assessment method. The practiced summative assessment question did not follow the instruction given in the documents, and this may be reflected in teacher's and concerned stakeholders' comprehension.

➤ Overall remarks on assessment methods

The teacher and concerned stakeholders have somewhat comprehend of assessment methods. Stakeholders' comprehension may be reflected in teacher's comprehension and practice.

4.5 Comprehension of the Extent of Students' Achievement of ILOs

4.5.1 The extent of students' achievement of ILOs by formative assessment

Stakeholders' views on the extent of students' achievement of ILOs

Formative assessment is conducted on demand in the beginning, middle, end or any time during the teaching learning activity of a class. However, a specific objective of formative assessment is to identify the learning status of students and take necessary action

accordingly (AG). To know the stakeholders' view, they were asked 'How to understand to what extent the ILOs have been achieved during conducting lessons. The PTI instructor1 said,

Asking students questions at the end of the lesson and their answering approach of spontaneity and silence help teachers to understand how much students' LO has been achieved. The teachers can take further steps accordingly. For example, if the teacher asked them the way of recovering from diarrhea, if they can they will answer spontaneously and if can't, they become silent.

In the statement PTII1 states that formative assessment has been conducted at the end of the lesson through questioning, and the extent of achieving ILO is understood by the students answering approach. This statement reveals the dearth of knowledge of PTII1 about the extent of ILO achievement. Hence, PTII1 has somewhat comprehension.

Further, it is mentioned in the assessment guide of primary science, teachers have to carry 'subject based assessment guide', textbooks, teacher's edition, subject based terminal competency, and class wise attainable competencies (NCTB, 2020). Formative assessment and teaching learning activities are interconnected. However, there are teaching learning activities and formative assessment instruction in the teacher's edition for each lesson (AG). To know stakeholders' view, they were asked about the information provided in AG, TB and TE to assess the extent of achieving the ILOs through formative assessment. In response the AUEO1 said,

Teachers do the assessment in each class with the help of the questions provided in TB and TE or they create their own questions and evaluate the students in class. We have also formatted the structure for classroom assessment.

In the statement of AUEO1, it reveals that AUEO1 was aware of the provided information in TB, TE, and the provided formatted structure for formative assessment. However, AUEO1 was unaware of subject based assessment guide. Therefore, AUEO1 has somewhat comprehension of the information provided in documents.

In addition to assess the learning of primary students, teachers get help of formative assessment format during teaching learning activities in the class (AG). To know the

classroom practice, stakeholders were asked about the practice to assess the extent of students' achievement of the ILOs through formative assessment. The teacher1 stated,

Students' achievement can be known by question-answer during class time focusing knowledge, understand and application. if the students give answers of what is soil? or explain characteristics of soil types or identify soil types for plants growth; then they achieve the ILO. We do not have any system to give them marks for formative assessment. If they can't answer then it is clear that they completely fail to achieve the ILO.

In the statement, T1 explained the way of assessing the extent to achieve the ILOs during conducting lessons without following any given instruction or format. This explanation revealed the unawareness of T1, from which it can be understood that T1 were somewhat comprehend about formative assessment.

A summary of findings is presented in the next table 4.40, where stakeholders' comprehension of the extent of students' achievement of ILOs by formative assessment.

Table 4.40: Summary of the findings on stakeholders' comprehension of the extent of formative assessment.

Stakeholders	Stakeholders view about the extent of achieving the ILOs through formative assessment			overall comprehension about the extent of ILO achievement through formative assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE about formative assessment extent	Practice of the extent of ILO achievement	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

From the table 4.40, it states that the teacher and concerned stakeholders have somewhat comprehension on the extent of students' achievement of ILOs by formative assessment.

4.5.2 The extent of students' achievement of ILOs by summative assessment

Stakeholders' view of the extent of students' ILO achievement

It is mentioned in the 'Assessment guide of primary education' that, one of the main objectives of summative assessment is what the student has learned and to what extent have learned (NCTB, 2020). In addition, summative assessment is the achievement of students or the assessment of LO of reading content based on a specific attainable competency in a

given time (NCTB, 2020). However, stakeholders were asked ‘How do you understand the extent of students’ ILO achievement by summative assessment? The AUEO1 said,

The focus of summative assessment is the acquisition of skills: knowledge, understanding and application. Thus, summative assessment is performed in stages with two types of direct questions: short response questions (SRQ) and constructive response questions (CRQ). The teachers assess the answer script following marking scheme.

In the statement, AUEO1 states of the summative assessment methods: question types and assess system by the teacher, which reveals AUEO1’s somewhat comprehension about the extent of students’ ILO achievement by summative assessment.

There is a format to complete the summative assessment of the primary level properly in the assessment guide of primary education. In addition, five segments are included in the format to assess the students (AG). Stakeholders were asked about the information provided in AG, TB, and TE to assess the extent of students’ achievement of ILOs. URC instructor1 said,

There are sample questions at the end of each chapter in TB and TE for summative assessment. Teacher assesses the answer script following the marking scheme provided by NAPE or the given number against each question in the question paper.

In the statement, it explores that, URCI1 stated about the traditional summative assessment methods without the information provided in AG about summative assessment. Hence, URCI1 has somewhat about the extent of students' ILO achievement by summative assessment.

The assessment guide of primary education provided a sample rubric for each subject to give numbers in essay type questions. There is also an instruction for the teacher to prepare their own subject rubric for summative assessment in the assessment guide. Stakeholders were asked about the practice of students’ assessment to achieve the ILOs by summative assessment. The teacher1 said,

Questions are asked a, b, c with numbers for knowledge, understanding and application in the summative assessment question paper, and I follow numbers against each question to assess. For example, knowledge-based answer is for one number, understand based answer is for 2 numbers and

application based answer is for a 3/4 number. If the students can give answer accurately, gets full marks; if can't then get fewer marks.

The statement explored the summative assessment process of T1, where T1 follow the instruction given in question to asses answer script that reveals T1 have somewhat comprehension about the extent of students ILO achievement by summative assessment.

A summary of the findings of stakeholders' comprehension about the extent of students' achievement of ILOs by summative assessment is shown in the next table 4.41.

Table 4.41: Summary of findings on stakeholders' comprehension about the extent of students' achievement of ILOs by summative assessment

Stakeholders	Stakeholders view about the extent of students ILO achievement by summative assessment			overall comprehension about the extent of students ILO achievement by summative assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE	Teacher's assessment system	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table reflects that the teacher and concerned stakeholders have somewhat comprehension about the extent of students' achievement of ILOs by summative assessment.

➤ Overall remarks

Teacher has somewhat comprehension on the extent of students' achievement of ILOs by summative assessment. Concerned stakeholders have somewhat comprehension in both the assessment and this may be reflected in teachers' comprehension and practices.

4.6 Challenges to Practice Inquiry in the Science Classroom

Challenges of practicing inquiry in the science classroom

Implementing inquiry teaching in a classroom is not an easy task and often encounters a good number of challenges (Edelson et al., 1999; Leonard et al., 2009). Teachers faced many challenges to the successful implementation of inquiry-based teaching in the science classroom and these challenges heavily impacted their implementation practices. The implementation of inquiry-based teaching depends to a large extent on teachers' successful

handling of a number of difficulties (PRIMAS, 2011). This study finds the most significant challenges from case A to the successful implementation of inquiry-based teaching in teacher and concerned stakeholders' interview sessions and these are presented in the next.

1. Perspectives on the meaning of inquiry-based teaching instruction

The perception of inquiry-based teaching instruction is a major concern that which activities do, and which do not create inquiry instruction. Bell et al. (2005) stated that students' activities may be simply referred to as hands-on activities rather an inquiry when they are not engaged in the analysis of data to generate the question answer. In the interview session, T1 said

I do not know inquiry, but try to follow TB instructions for conducting lessons. I do the provided activity whenever I can but, can't engage a large number of students.

AUEO1 said,

Inquiry is learning science by doing, but our students cannot read properly, so what will we do with science activities. Therefore, the main goal is to teach the text to the students properly.

In the statements, it is revealed that there are different perspectives on the meaning of inquiry-based teaching instruction and that learning with hands-on activities by the students is inquiry-based learning.

2. The divergent perspectives of what constitutes appropriate guidance of inquiry

The most rational level of appropriate guidance must reflect in the inquiry process with a balance between learners and teachers, and the level of guidance and support depend on who is responsible for the inquiry activity. The instructor who becomes a facilitator in inquiry teaching may provide vital kick-starter guidance on a minimal scale that is appropriate to learners (Blanchard et al., 2010). In the interview session, URC Instructor1 said,

Elementary students are too young to do any activity, so teachers do first and then follow it.

PTI Instructor said,

Teachers of elementary level have to do the activity, our students of this level are so young and they cannot do the activity.

In the statements, divergent perspectives of what constitutes appropriate guidance of inquiry.

3. The threat of time management

Time for an inquiry-based science lesson preparation for learners' meaningful learning in class has been identified as a reason why teachers do not prefer inquiry-based methods.

In this context T1 said,

I have to conduct different subjects rather than science in different grades, and we have a large number of students; so it is a big challenge for me to design science classes with activities and manage a large number of students.

PTI Instructor1 said,

Teachers of elementary level have to do many govt. assigned work besides classes, so they lose their interest and do not get time to ready for an activity-based class.

In the statements time management is mentioned as a reason for not practicing activity in the science classroom.

4. Deficiency in inquiry-based instructional techniques and strategies

The appropriate knowledge of content and pedagogy considered teachers' overall instructional methods, strategies, and skills with a specific focus on the inquiry-based lesson. In line with this AUEO1 said,

In the primary level, there is no subject-based teacher. Any teacher can conduct any subject of any grade. Therefore, teachers do not have background knowledge in all the subjects of primary grade as well as pedagogical knowledge also.

URCI1 said,

Teachers get different types of training but all of them are not subject-based teachers, so they have gaps in content knowledge as well as pedagogy also.

The statements reveal that lack of content and pedagogical knowledge prevent them to follow proper instructional methods, strategies and skills with a specific focus on the inquiry-based lesson.

5. Professional development outcomes

Research has shown that short-term training of teachers on inquiry instruction did not changes teachers' practice (Yoon et al., 2007). Teacher and concerned stakeholders were unanimous in the statement that teachers need regular professional training and monitoring for their development. AUEO1 said,

Our teachers did not get training on the curriculum and all the subjects that they have to teach in the classroom; based on subject teaching learning activities are different and it needs proper content and pedagogical knowledge also.

PTII said,

All teachers of elementary grades get PTI training, besides this, they get others training. But maybe it is not sufficient for them, so different year-round training has to arrange for teachers' professional development.

The statements reveal that year-round training for their professional development is helpful for inquiry teaching.

6. Commitment to inquiry

The commitment to work towards the implementation of inquiry-based teaching as an approach to science learning. Teacher1 stated,

Activity-based classes need more time and it's impossible to engage a large number of students in the activity. However, students in primary grade cannot do the activity on their own and cannot read properly. Therefore, I prefer reading rather than activity in science classes; sometimes I do the activity and show them.

AUEO said,

We have a large number of students in a class. Sometimes we have other some obstacle like seating arrangement, activity apparatus, teaching assistance, etc. Teachers are not that much committed to conducting activity-based classes by managing all these obstacles.

The statements disclose that commitment to inquiry as an issue of introducing inquiry-based lessons.

7.Lack of collegial supervision

Senior teachers could provide empirical advice to others with their teaching experiences, content, and pedagogical expertise. School authorities, as well as teachers, formed formal and informal learning communities with colleagues to exchange teaching ideas. T1 claimed,

I am new to conduct science classes, and I am learning day by day to develop myself. I try to get support from my senior and headteacher, but sometimes it is not possible due to their busyness. But the support from colleagues is vital to prepare me.

URCI1 said,

Teacher can get support from other experienced teachers and share their teaching planning. School authority can develop learning community platform for teacher

The statements disclose that collegial supervision play a vital role for practicing inquiry.

8. Insufficient guides for connecting curriculum and inquiry teaching

To implement inquiry-based teaching, there needs sufficient guidance for connecting curriculum and inquiry. Teaching learning activities of science curriculum is designed the following inquiry. In their interview session PTII1 said,

Teachers of elementary level get PTI training as professional training. But they need specific training on subject pedagogy, curriculum instruction, and inquiry instruction for science teaching; as inquiry is the basis for science teaching.

URCI1 said,

Teachers can get support from other experienced teachers and share their teaching planning. School authority can develop a learning community platform for teachers. Curriculum instruction and the inquiry for science teaching, otherwise, they cannot do inquiry in the classroom.

The statements reveal that insufficient guides for connecting curriculum and inquiry teaching prevent inquiry teaching.

Case study B

In this case, teacher 2 was from a rural area. Concerned stakeholders were the PTI instructor, URC instructor, and AUEO, who supervise the teacher through training and monitoring. Some students of teacher 2 also participated in FGD.

The following section explores teacher's and concerned stakeholders' comprehension of intended learning outcomes through semi-structured interviews. Here, teacher and concerned stakeholders' responses explore their level of comprehension about the focus of ILOs.

4.7 Stakeholders' Comprehension about the Focus of ILOs

Teacher's classroom practice

It has been explored from the four observed lessons that, the teacher2 focused only knowledge level of ILO the other two focuses: skill and attitude are absent. Table 4.42 presents T2's lessons practice focusing on ILO.

Table 4.42: Teacher 2's classroom practice about the focus of ILOs in Grade-5, Chapter-Information in our life

No of ILO	ILO in TE	Lessons in TE	Lesson title	Lessons are taken by teacher2	Teacher's focus on ILO
11.1.1	Will be able to explain the importance of information exchanges in visual, social and national life.	Lesson-1	Importance of information sharing	Lesson-1	Focused only knowledge
		Lesson-2			

Stakeholders' views

In response to the question 'What is the intended learning outcome-explain with example.' T2 replied,

LO helps the teacher to understand what students will learn from today's lesson, it is specific for each lesson, so all teacher has to follow it strictly and the learning is the same for all, otherwise teacher focuses on their own and the learning focus will be different.

In the statement, T2 explained ILO as students' achievement of knowing and identifying something from content. However, the other two important focuses of ILOs-skill and

attitude, are absent in the explanation; which reveals the teacher's somewhat comprehension of ILO.

In the interview, when asked 'What is the importance of ILO focus-explain with example?' AUEO1 said,

Competency does not achieve without LO, lessons are worthless if you do not determine what your learner will learn, so the purpose of the lesson must be well-defined in advance. For example, when you give the students a project on tree planting through seedlings, if it is not selected earlier that loamy soil is suitable and sandy soil is not suitable for seedlings, the students can't do the project, you have to tell them to advance which soil is suitable for which plant then they will learn and do the project.

In the statement, AUEO2 stated that the importance of ILO focus is knowledge, understand, and application, which reveals AUEO2's somewhat comprehension of the importance of ILO focus.

In response to the question 'How did you identify the focus of ILO-explain with example?', the PTI instructor 2 said,

The focus of LO is knowledge, understand, and application according to Bloom's taxonomy at primary level. The action verb of LO helps to understand the focus of LO. For example, for knowledge the LO is-will be able to define polluted water, students will be given answer to any definition, for understand-will be able to state the causes of water pollution, for application-will be apply their knowledge of water pollution, and stop their others to drink any kind of polluted water with explain its bad effects.

In the statement of PTII2, the common terms of ILO focus are knowledge, understand, and application, which reveals somewhat comprehension of PTII2 about ILO focus.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that TB did not mention ILOs, and TE mentioned ILOs but did not address the focus of ILO.

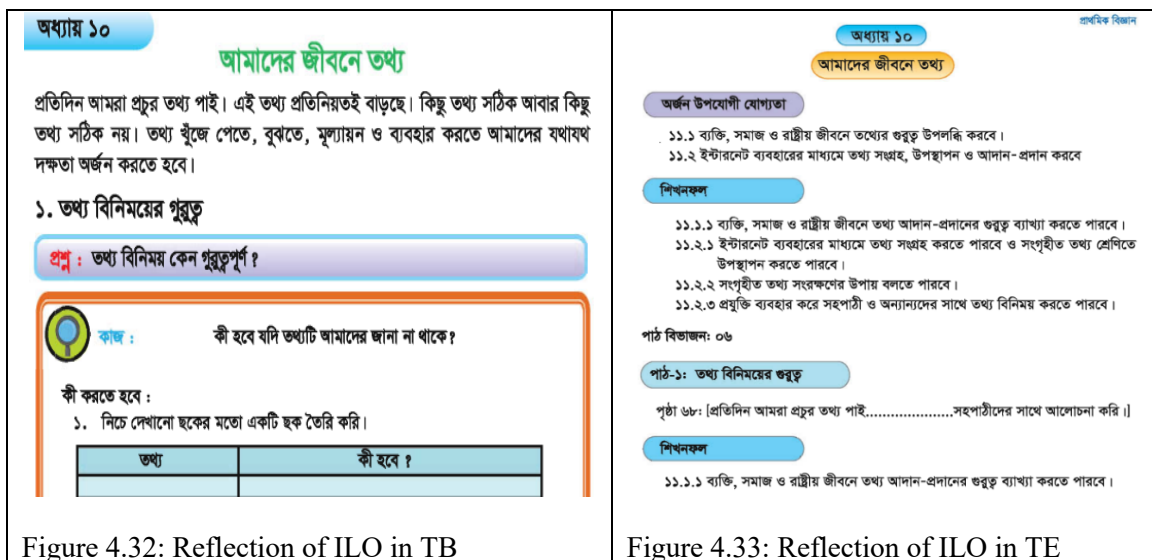


Figure 4.32: Reflection of ILO in TB

Figure 4.33: Reflection of ILO in TE

A summary finding of stakeholders' level of comprehension about the focus of the intended learning outcome is presented in the table next.

Table 4.43: Summary of findings on stakeholders' comprehension about the focus of ILOs

Stakeholders	Stakeholders' view on the focus of ILOs			Overall comprehension of ILOs	Chapter, Lesson & no. of ILO in Grade three	Teacher's lesson practice	Information provided (Based on a literature review)	
	Meaning of ILO	Importance of ILO focus	Way of identifying ILO focus				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 10 Lesson: 1 ILO: 11.1.1 Lesson: 2 ILO: 11.1.1	lessons-1: somewhat practiced	Not addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 3 ILO: 11.2.1 11.2.2 11.2.3 Lessons: 4 ILO: 11.2.1 11.2.2 11.2.3 Lessons: 5 ILO: 11.2.2 11.2.31 Lessons: 6 ILO: 2.2.31	lessons-2: somewhat practiced	Not addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 11 Lesson: 1 ILO: 13.1.1 13.1.2 Lesson: 2 ILO: 13.1.1 13.1.2	lessons-3: somewhat practiced	Not addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson: 3 ILO: 6.1.1 7.1.2 13.3.1 Lesson: 4 ILO: 13.2.1	lessons-4: somewhat practiced	Not addressed	Somewhat addressed

The table reveals that the teacher and concerned stakeholders somewhat comprehend the focus of ILOs. The teacher somewhat practiced ILO focus in the science classroom. ILOs did not address in textbooks, and were somewhat addressed in the teacher's edition.

➤ Overall remarks

Teacher 2 has somewhat comprehension about the focus of ILOs which was reflected in T2's lessons practice. Concerned stakeholders also have somewhat comprehension of the focus of ILOs; that may be reflected in teacher's comprehension as they are engaged in teacher training, supervision, and monitoring. The provided information of curriculum documents also may be reflected in concerned stakeholders' comprehension and T2's comprehension, and lesson practice.

4.8 Stakeholders' Comprehension of the Approach of Primary Science Textbooks and Teacher's Edition

4.8.1 Starting lesson with a key question

Teacher's classroom practice

It has been explored from the four observed lessons that, the teacher started classes with lesson title related song and then explored students' prior knowledge through question-answer. After that, the teacher started teaching-learning activities and did not focus on key question. Moreover, teacher 2 conducted more than one lesson in one class. Table 4.44 presents the way of starting a lesson by teacher 2.

Table 4.44: Teacher 2's classroom practice about starting lesson with a key question in Grade-5, Chapter-Information in our life

ILO	Lessons in TE	Lesson title	No. of lessons taken by the teacher	Lesson objectives are given in TE for key question	The key question is given in TE and TB	Teacher's focus on the key question	Way of starting a lesson by the teacher
11.1.1	1	Importance of information sharing	Lesson-1	*Is information sharing important? *How can we exchange information?	Why is information sharing important?	did not mention	Lesson title-related song

Stakeholders' views

To know the stakeholders' views, they were asked about the importance of key question to start a lesson. Among them teacher 2 said,

It helps me to find out the lesson title from the students, they can understand the lesson which we are going to teach today, for example, I asked them-how could we get news, and they replied their own so I declare the lesson title.

The statement reveals that T2 has a misconception about the key question, and mentioned it as prior knowledge exploring the question. Hence, T2 does not comprehend the approach of starting a lesson with a key question.

In response to the question 'What are the focuses of key question to start a lesson in textbooks and teacher's edition?', among the stakeholders the PTI instructor said,

Usually, I highlight JICA provided teaching package in training session of DPED program, instruct the trainee teacher to follow it. Besides this, I also suggest NCTB provided TE, I saw TE but do not follow it accordingly.

The above statement reflects PTII2's unawareness of TB and TE as PTII2 did not notice the provided key question in TB and TE that way.

Stakeholders were asked about classroom practice of key question to start a lesson. The teacher had the reply that,

Students have prior experience; I ask them questions to know their prior knowledge about the lesson and to get the lesson title.

The statement explores that, the teacher 2 focuses on prior knowledge and exploring question in the starting of a lesson for conducting lesson. Therefore, teacher2 did not comprehend the practice of key question in the science classroom.

Students' response in FGD

Students of FGD were asked about the way of starting lesson. Their common response was, usually their class starts with reading text from books. One of them stated,

Usually, our class starts with lesson-related songs, sometimes rhymes or some questions; we answer if we can't then sir reply to us.

In the above statement of a student, it is asserted that the teacher does not focus on key question to conduct a lesson.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on the key question to start a lesson. The key question is highlighted at the starting of teaching-learning activities of each lesson in TB and TE. Therefore, this approach is extremely addressed in TB and TE.

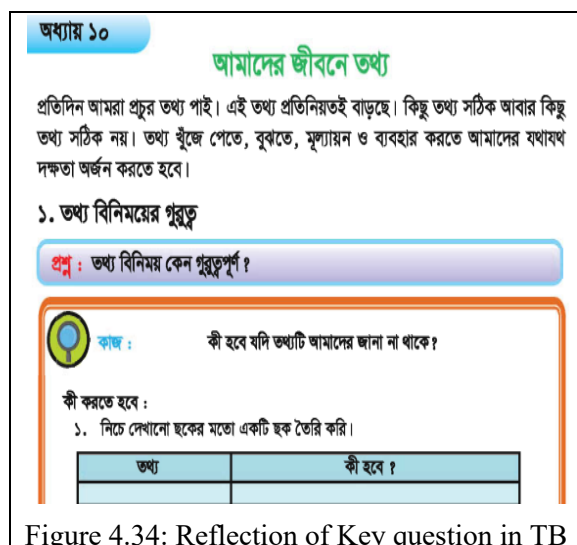


Figure 4.34: Reflection of Key question in TB

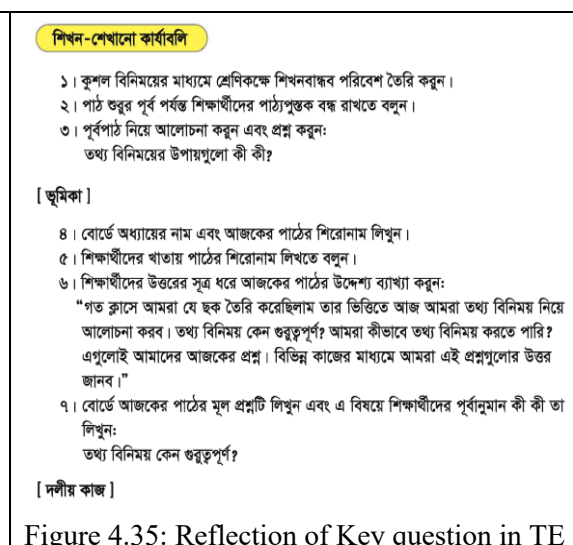


Figure 4.35: Reflection of Key question in TE

Table 4.45 summarized the findings of document analysis, lesson observations, and stakeholders' comprehension to start a lesson.

Table 4.45: Summary of findings of starting lesson with a key question

Stakeholders	Stakeholders' comprehension about starting lesson with a key question			Overall comprehension	Chapter, Lesson & no. of ILO in Grade five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of key question	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:10 Lesson: 1 Lesson: 2	lessons-1: somewhat practiced	Extremely addressed	Extremely addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lessons-2: somewhat practiced	Extremely addressed	Extremely addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lessons-3: somewhat practiced	Extremely addressed	Extremely addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson: 3 Lesson:	lessons-4: somewhat practiced	Extremely addressed	Extremely addressed

The findings reveal that teacher and concerned stakeholders did not comprehend about starting lesson with a key question. The teacher did not focus key question in the science classroom. The key question extremely is addressed in textbooks (TB) and teacher's edition (TE).

➤ Overall remarks

The teacher did not comprehend of starting lesson with a key question and that was reflected in lessons practice as T2 did not focus key question in the science classroom. Also concerned stakeholders did not comprehend, which may be reflected in teacher's comprehension and classroom practices.

4.8.2 Exploring students' prior knowledge

Teacher's classroom practice

The observed lessons have been explored that, the teacher had explored students' prior knowledge for the first lesson and explored review of the lesson for the other lessons in his own way. However, that reveals students' prior knowledge exploration partially. After that, the teacher started teaching learning activities. The teacher's classroom practice of prior knowledge exploration of a lesson is shown in table 4.46.

Table 4.46: Teacher 2's classroom practice about exploring students' prior knowledge in Grade-5, Chapter-Information in our life

ILO	Lesson in TE	Lesson title	No. of taken classes by the teacher	Prior knowledge exploring Q. given in TB	Prior knowledge exploring Q. given in TE	Question from previous lesson given in TE	Exploring prior knowledge by the teacher
11.1.1	1	Importance of information sharing	1	-	-how can we collect information? -how can we exchange collected information?	-	-how can we collect information? -how can we exchange collected information?
11.1.1	2				-	What are the ways of exchanging information?	

The table express that the teacher has taken two lessons in one class and explored students' prior knowledge focusing only first lesson. Therefore, teacher's classroom practice has been considered somewhat practiced regarding students' prior knowledge exploration.

Stakeholders' views

Stakeholders were interviewed to know their views about exploring students' prior knowledge. In response to the question 'What is the importance of exploring students' prior knowledge in the relevant topic?', URC instructor2 said,

It is essential because the teacher asks a question on today's lesson during prior knowledge exploration so that he/she can know students' gap and can design the class depending on that.

In the statement, URCI2 stated that prior knowledge exploration is for students' knowledge of today's lesson. This response explores URCI2's somewhat comprehension because sometimes it may be in previous lessons also.

Stakeholders were asked about the scope of prior knowledge exploration in lessons in TE and TB. Among the responses, AUEO2 said,

It may be at elementary science TB and TE but I did not see it that way for my busy schedule, as I have to observe all subject class.

It appears from the statement that, AUEO2 was unaware of TB and TE as AUEO2 claimed time constraints for that.

In addition, stakeholders were further asked about the classroom practice of students' prior knowledge exploration. The teacher had the reply that,

I always try to ask questions on previous lessons to know students' sustainability in the early lessons, then questions on today's lesson to know their prior knowledge about today's lesson.

In the statement, T2 explained prior knowledge exploration is needed to sustain their previous knowledge or get the lesson title, which is going to teach today. This explanation expressed T2's somewhat comprehension of classroom practice of prior knowledge exploration.

Students' response in FGD

Students were asked about classroom practice of prior knowledge exploration. One of them had the reply that,

Usually, their class starts with reading a book. Sometimes, the teacher asked them questions about today's lesson or sometimes from the previous lesson.

The statement reveals occasional classroom practice of prior knowledge exploration.

Information provided in TB and TE

Analyzing the observed lessons, conducted by T2 from primary science textbooks it is found that, a very short introduction is placed in the starting of each before teaching learning activity (Figure 4.36). Usually, teacher use it for prior knowledge exploration, which was also found in lesson observations and interviews. Analyzing the observed lessons in TE it is found that, TE addressed prior knowledge exploring questions for the first lesson of a chapter (Figure 4.37), and addressed questions of review of the previous lesson for the rest lessons (Figure 4.38).

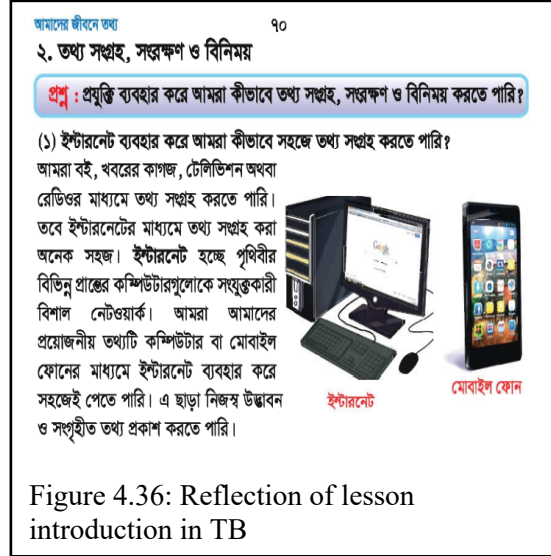


Figure 4.36: Reflection of lesson introduction in TB

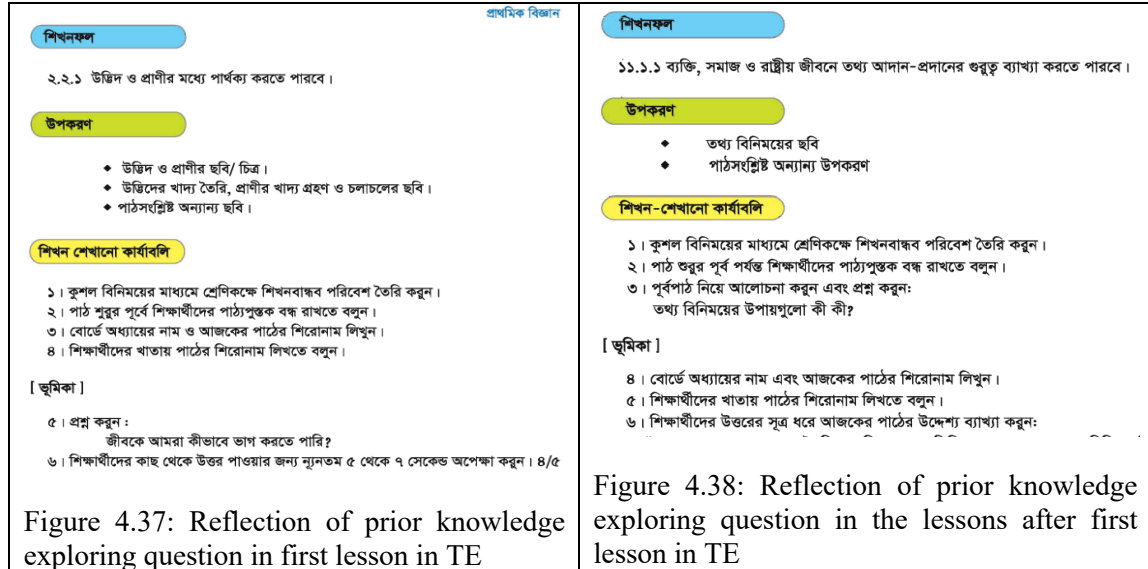


Figure 4.37: Reflection of prior knowledge exploring question in first lesson in TE

Figure 4.38: Reflection of prior knowledge exploring question in the lessons after first lesson in TE

Although the lessons in a chapter are interrelated and all lessons contain some new additions; therefore, exploring students' prior knowledge is needed besides reviewing the

previous lesson in each lesson. Consequently, the Information provided for prior knowledge exploration in TE has been considered as somewhat addressed.

A summary of the findings of documents analysis, lesson observations, and stakeholders' comprehension regarding prior knowledge exploration is presented in the next table.

Table 4.47: Summary of findings about exploring students' prior knowledge

Stakeholders	Stakeholders' comprehension of exploring students' prior knowledge			Overall comprehension	Chapter, Lesson & no. of ILO in Grade five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of exploring students' prior knowledge	Given the information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 10 Lesson: 1	lessons-1: somewhat practiced	Somewhat addressed	Somewhat addressed
					Lesson: 2			
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 3	lessons-2: somewhat practiced	Somewhat addressed	Somewhat addressed
					Lessons: 4			
					Lessons: 5			
					Lessons: 6			
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 11 Lesson: 1	lessons-3: somewhat practiced	Somewhat addressed	Somewhat addressed
					Lesson: 2			
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson: 3	lessons-4: somewhat practiced	Somewhat addressed	Somewhat addressed
					Lesson: 4			

The findings reveal that, the teacher and concerned stakeholders have somewhat comprehension about exploring students' prior knowledge. However, the teacher sometimes explores students' prior knowledge in the science classroom. The information about exploring students' prior knowledge is somewhat addressed in textbooks (TB) and in teacher's editions (TE).

➤ Overall remarks

The teacher has somewhat comprehension of exploring students' prior knowledge; and that was reflected in T2's lessons practice as T2 somewhat explore students' prior knowledge in the science classroom. However, concerned stakeholders have somewhat comprehension this may be reflected in teacher's comprehension and classroom practices.

4.8.3 Real-life orientation of science concept

Teacher's classroom practice:

It has been observed in lesson observations that, the teacher tried to orient the science

concepts with some real-life examples and with a very small amount of real material in own way. However, the number of supplied teaching aid was not sufficient for teaching learning activities in all the observed classes of T2, which is indicated as somewhat practice in Table 4.48. Out of four observed lessons of T2, one is shown in table 4.48 as teacher's classroom activity.

Table 4.48: Teacher 2's classroom practice about real-life orientation of science concepts in Grade-5, Chapter-Information in our life

ILO	Lesson no at TE	Lesson title	Lesson taken by the teacher	Real life orientation activities and example mentioned at TB	Real life orientation activities and example mentioned at TE	Activities done by the teacher
11.1.1	1	Importance of information sharing	1	Examples from daily life	Examples from daily life	Examples from daily life
11.1.1	2					

Stakeholders' views

To know about the necessity of linking real-life situations with science concepts, stakeholders were asked question. The URC instructor2 said,

It is very important to connect science concepts with real life situations. Students can easily understand the concept when it is related to their daily life and the learning becomes meaningful.

In the statement, URC instructor2 explained the necessity of real-life orientation with science concepts for meaningful learning; which reveals URCI2's moderate comprehension.

In response to the asked question about the scope of linking real-life situations with science concepts in lessons of TE and TB, PTI instructor2 said,

Most of the content is aligned with real-life context at TB and TE. For example, in chapter water, the example of pure water and polluted water sources are given from our surroundings, so students can easily identify the sources.

The statement explores PTI2's moderate comprehension of TE and TE.

To know the stakeholders' views, they were asked to response about the classroom practice of linking real-life situations with science concepts. Among the stakeholders, Teacher2 said,

I always try to show students available teaching aid from their daily life and give examples of science concepts from real-life, for example-in the lesson ‘information in our life’, I tried to give examples with the available known things like TV, telephone, mobile, internet, pen drive.

The statement expresses T2’s moderate comprehension of linking science concepts with real life in the science classroom.

Students’ response in FGD

In response to the asked question about the classroom practice of orient science concepts with real life, one of them replied that,

Teacher gives us example with our surroundings known things and sometimes carry some sample materials in class. However, the sample materials are too limited that we can’t follow the sample materials.

In the statement of a student, it is expressed that teacher2 somewhat focus on orientation of science concepts with real life.

Information provided in TB and TE

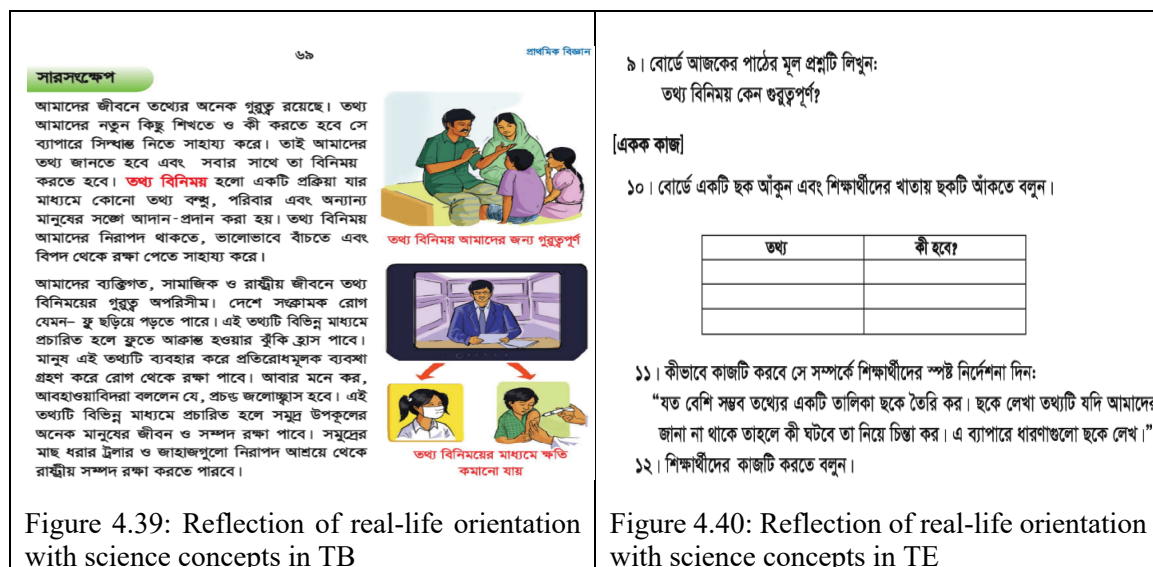


Figure 4.39: Reflection of real-life orientation with science concepts in TB

Figure 4.40: Reflection of real-life orientation with science concepts in TE

Analyzing the existing primary science textbooks and teacher’s edition it is found that both TB and TE provided some real-life examples connecting with science concepts.

The finding of documents analysis, lesson observations, and stakeholders’ comprehension regarding the orientation of science concepts with real life are summarized in table.

Table 4.49: Summary of findings about real-life orientation in science concept

Stakeholders	Stakeholders' comprehension regarding orientation of science concepts in real life			Overall comprehension	Chapter, Lesson & no. of ILO in Grade five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of orienting science concept	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter: 10 Lesson: 1 Lesson: 2	lessons-1: somewhat practiced	Moderately addressed	Moderately addressed
PTI instructor	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lessons-2: somewhat practiced	Moderately addressed	Moderately addressed
URC instructor	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lessons-3: somewhat practiced	Moderately addressed	Moderately addressed
AUEO	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Lesson: 3 Lesson: 4	lessons-4: somewhat practiced	Moderately addressed	Moderately addressed

The findings of table reveal that, the teacher and concerned stakeholders have moderate comprehension of orientation of science concepts with real life. However, the teacher somewhat orient science concept with real life. The information of the orientation of science concepts with real life is moderately addressed both in textbooks (TB) and in teacher's edition (TE).

➤ Overall remarks

Teacher 2 has moderate comprehension of orientation of science concept with real life; but T2 somewhat practice it in the science classroom. However, concerned stakeholders have moderate comprehension; and that may be reflected in the teacher's comprehension. Curriculum documents were also moderately addressed, and this may be also reflected in teacher and concerned stakeholders' comprehension.

4.8.4 Science process skills

Teacher's classroom practice

It has been explored from the observed lessons that, T2 practiced slightly or sometimes did not practice science process skills in science classes. The teacher's classroom practice focusing science process skill of a lesson is shown in table 4.50, where T2 slightly focuses on observation.

Table 4.50: Teacher 2's classroom practice of science process skills in Grade-5, Chapter- Information in our life

ILO	Lesson in TE	Lesson title	No. of classes taken by the teacher	Science process skills given in TB	Science process skills given in TE	Teacher's classroom activity
11.1.1	1	Importance of information sharing	1	Prediction, communication	prediction	Did not focus any process skills
11.1.1	2				Prediction, Discussion making, communication	

Stakeholders' views

Stakeholders were asked 'What are the opportunities of students for achieving science process skills through science learning?'. PTII2 alluded,

Process skills are necessary for science learning and our TB content are arranged focusing science process skills. So, students develop science process skills through science learning. For example, they can observe, measure, classify.

The statement explores PTII2's moderate comprehension about science process skills.

In response to the question about the information provided in TE and TB about the opportunities for the students to achieve science process skills through science learning, T2 said,

I do not understand process skills, is it students' skills? So, this is how much students received the knowledge, if not what is its cause? Actually, I did not see it at TE and TB that way.

In the statement T2 stated that, T2 did not comprehend science process skills and did not see the information provided in TB and TE that way.

On the basis of asked question about the classroom practice of achieving science process skills through science learning, URC instructor2 said,

Though TB focus science process skills but these are high thought matter not for primary level. Our teacher did not understand it and do not practice it at classroom.

In the statement reveals URCI2's unawareness about science process skills and URCI2 have somewhat comprehension about science process skills.

Students' response in FGD

In response to the asked question about the classroom practice of achieving science process skills through science learning, one student of FGD asserted,

Usually, our teacher did some activity in front of the class by own self.
But we did not engage with it, we only see it from our seating place.

From the statement, it is exposed that T2 did not focus on science process skills in the classroom.

Information provided in TB and TE

Analyzing the primary science textbooks and teacher's editions it is found that, there are some activities in each lesson focusing on science process skills like; demonstration, observation, experiment, investigation, and decision-making (NCTB, 2020).

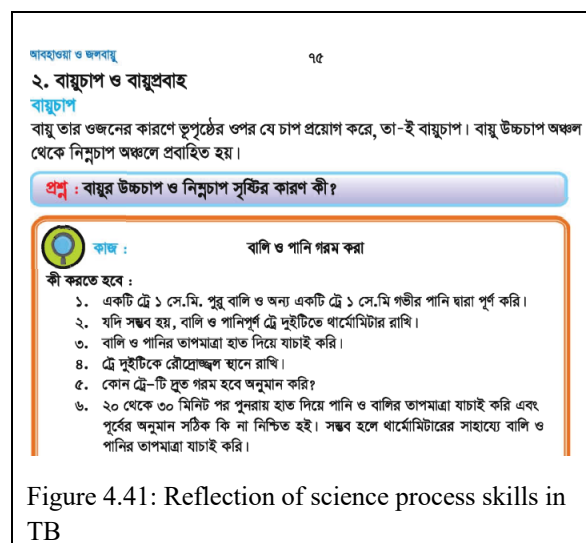


Figure 4.41: Reflection of science process skills in TB

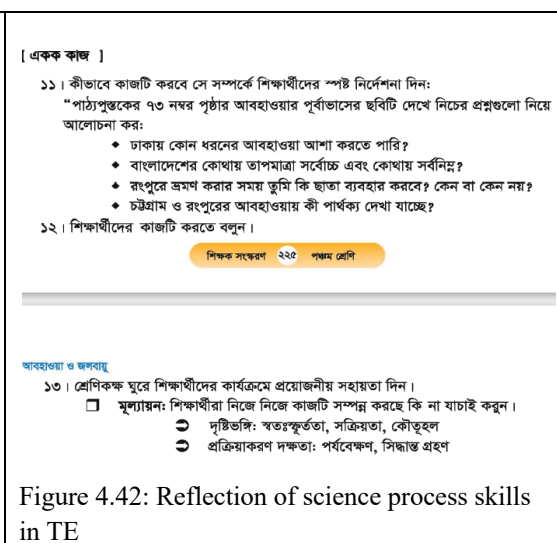


Figure 4.42: Reflection of science process skills in TE

Figure 4.41, reflects the science process skill of a lesson in TB. Here, observation skill is mentioned for identifying different types of soil. Figure 4.42 reflects science process skills in TE where also observation skills are mentioned.

The findings about science process skills from documents analysis (TB & TE), lessons observation, and stakeholders' comprehension are summarized in next table.

Table 4.51: Summary of findings about science process skills.

Stakeholders	Stakeholders' comprehension about science process skills			Overall comprehension	Chapter, Lesson & no. of ILO in Grade five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of science process skills	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:10 Lesson: 1	lessons-1: did not practice	Somewhat addressed	Somewhat addressed
					Lesson: 2			
PTI instructor	Moderately comprehend	somewhat comprehend	Moderately comprehend	Moderately comprehend	Lessons: 3	lessons-2: did not practice	Somewhat addressed	Somewhat addressed
					Lessons: 4			
					Lessons: 5			
					Lessons: 6			
URC instructor	somewhat comprehend	somewhat comprehend	Not comprehend	somewhat comprehend	Chapter: 11 Lesson: 1	lessons-3: did not practice	Somewhat addressed	Somewhat addressed
					Lesson: 2			
AUEO	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Lesson: 3	lessons-4: did not practice	Somewhat addressed	Somewhat addressed
					Lesson: 4			

The findings of the table reveal that concerned stakeholders have moderate to somewhat comprehension, sometimes did not comprehend science process skills. T2 did not comprehend science process skills, and T2 did not focus on science process skills in science classroom. Science process skills were somewhat addressed in the analyzed lessons of TB and TE that were observed.

➤ Overall remarks

The teacher did not comprehend science process skills, and this was reflected in science classroom practice. However, concerned stakeholders have moderate to somewhat comprehension; and that may be reflected in teacher's comprehension and classroom practices. Curriculum documents are also addressed moderately and this may be reflected in the concerned stakeholders' comprehension.

4.8.5 Activity-based class

Teacher's classroom practice

It has been explored from the observed lessons that, T2 did not engage in any activities in the classroom. The next table presents T2's classroom activity of activity-based class.

Table 4.52: Teacher 2's classroom practice of activity-based class in Grade-5, Chapter-10

ILO	Lesson at TE	Lesson title	No. of classes taken by the teacher	Given activities in TB	Given activities in TE	Teacher's activity in classroom
11.1.1	1	Importance of information sharing	1	Single work (fill up the table) -discuss with group	Single work (fill up the table)	Write a Q&A with group discussion
11.1.1	2				Group discussion with given questions	

Stakeholders' views

Stakeholders were asked about the importance of activity-based classes for science teaching-learning. In response, AUEO2 said,

Teacher can find out the lesson through students' activity, learning outcome will be achieved by students' active participation through group work. This is not only for science, activity-based class is needed for each subject.

In the statement, AUEO2 stated activity-based class as group work that reveals URCI1's somewhat comprehension of activity-based class.

In response to the question about the Information provided of opportunity for activity-based classes in TE and TB, the PTII2 instructor said,

Content related activities are provided at TB and TE, I see the TB but did not see TE that way.

The statement reveals that T2 was unaware of TB and TE provided information about activity-based class.

Stakeholders were asked about the classroom practice of activity-based classes. URC instructor2 said,

Actually, students enjoy a lot with group work, our teacher tries to engage the students with group discussion.

In the statement, URCI2 explained activity-based learning as group work with group discussion, and that reveals URCI2's somewhat comprehension about activity-based learning.

Students' response in FGD

Students of FGD were asked about the classroom practice of activity-based learning. One of them had the reply that,

Usually, we do not get the chance to do any activity in science classes. Sometimes the teacher did it only in front of the class by own self.

The statement also explores T2's classroom practice that T2 did not practice activity-based learning in the science classroom.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that there are activities in each lesson (Figure 4.43 & 4.44).

প্রশ্ন : তথ্য বিনিময় কেন গুরুত্বপূর্ণ ?

কাজ : কী হবে যদি তথ্যটি আমাদের জানা না থাকে ?

কী করতে হবে :

১. নিচে দেখানো ছকের মতো একটি ছক তৈরি করি।

তথ্য	কী হবে ?

২. যত বেশি সম্ভব তথ্যের একটি তালিকা ছকে লিখি।
৩. ছকে লেখা তথ্যটি যদি আমাদের জানা না থাকে তাহলে কী ঘটবে ?
৪. এ ব্যাপারে ধারণাগুলো ছকে লিখি।
৫. কাজটি নিয়ে সহপাঠীদের সাথে আলোচনা করি।

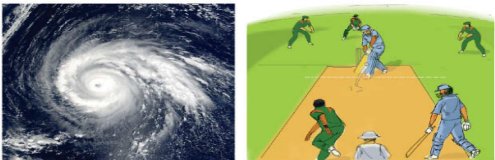


Figure 4.43: Reflection of activity-based content in TB

[একক কাজ]

১০। রোডে একটি ছক আঁকুন এবং শিক্ষার্থীদের স্বাতন্ত্র্য ছকটি আঁকতে বলুন।

তথ্য	কী হবে?

১১। কীভাবে কাজটি করবে সে সম্পর্কে শিক্ষার্থীদের স্পষ্ট নির্দেশনা দিন:
"যত বেশি সম্ভব তথ্যের একটি তালিকা ছকে তৈরি কর। ছকে লেখা তথ্যটি যদি আমাদের জানা না থাকে তাহলে কী ঘটবে তা নিয়ে চিন্তা কর। এ ব্যাপারে ধারণাগুলো ছকে লেখ।"

১২। শিক্ষার্থীদের কাজটি করতে বলুন।

১৩। শ্রেণিকক্ষে ঘুরে শিক্ষার্থীদের কার্যক্রমে প্রয়োজনীয় সহায়তা দিন।

- ☐ মূল্যায়ন: শিক্ষার্থীরা নিজে নিজে ছকটি তৈরি করেছে কি না, তা যাচাই করুন।
 - ☞ দৃষ্টিভঙ্গি: সক্রিয়তা, স্বতঃস্ফূর্ততা, কৌতূহল
 - ☞ প্রক্রিয়াকরণ দক্ষতা: পূর্বানুমান

১৪। শিক্ষার্থীরা ছকটি তৈরি করেছে কি না, তা যাচাই করুন।

১৫। পরবর্তী পাঠে করণীয় সম্পর্কে শিক্ষার্থীদের নির্দেশনা দিন এবং ধন্যবাদ জানিয়ে আজকের পাঠ সমাপ্ত করুন।

শিক্ষক সংকল্প ২০৬ পঞ্চম সেটি

Figure 4.44: Reflection of activity-based content in TE

A summary of findings of the activity-based class from documents analysis (TB & TE), lesson observations, and stakeholders' comprehension are presented in the table next.

Table 4.53: Summary of findings about activity-based class

Stakeholders	Stakeholders' comprehension about activity-based class			Overall comprehension	Chapter & Lesson in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of activity-based class	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 10 Lesson: 1 Lesson: 2	lessons-1: did not practice	Somewhat addressed	Moderately addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lessons-2: did not practice	Somewhat addressed	Moderately addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lessons-3: did not practice	Somewhat addressed	Moderately addressed
AUEO					Lesson: 3			

Stakeholders	Stakeholders' comprehension about activity-based class			Overall comprehension	Chapter & Lesson in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of activity-based class	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend		Lesson: 4	lessons-4: did not practice	Somewhat addressed	Moderately addressed

The findings of the table reveal that, T2 did not comprehend about activity-based class. Concerned stakeholders have somewhat comprehension. T2 did not practice the activity in the science classroom. The information somewhat addressed in TB, and moderately addressed in TE for activity-based class.

➤ Overall remarks

Teacher 2 did not comprehend activity-based science classes, and this was reflected in T2's classroom practice. However, concerned stakeholders have somewhat comprehension; and this may be reflected in the teacher's comprehension and classroom practices.

4.8.6 Collaborative approach

Teacher's classroom practice

Out of four lessons, the teacher did not seat the students into groups for a group activity or group discussion. Therefore, the students did not get the chance to cooperate with each other with the activity or share their idea about the lessons. The teacher's focus was only on reading the text. Teacher's classroom activity of a lesson is shown in next table.

Table 4.54: Teacher 2's classroom practice of collaborative approach in Grade-5, Chapter-10

ILO	Lesson in TE	Lesson title	No. of class taken by the teacher	Collaborative approach given in TB	Collaborative approach given in TE	Teacher's activity in classroom
13.1.1 13.1.2	1	differences between	3	-Group discussion with given question	-	Write a Q&A with group discussion (assessment)
13.1.1 13.1.2	2	weather and climate			-Group discussion with given question	

Stakeholders' views:

Stakeholders were asked for their opinion about the collaborative approach in science

teaching-learning. Teacher 2 said,

Students learn through sharing their idea in group work or discussion, this is collaborative learning. For example, after finishing my lesson I said the students to write the Q&A of difference between climate and weather? With group discussion.

In the statement T2 explained collaborative approach as group work or group discussion but T2 use it for assessment after finish lesson, that reveal T2's somewhat comprehension about collaborative approach.

Analyzing the new primary science textbooks and teacher's edition, it is found that there is mentioned to discuss with classmates as well as instructed group activities in all lessons. Stakeholders were asked about the opportunity of collaborative approach mentioned in TE and TB. Among the stakeholders, The PTI instructor said,

Both TE and TB mentioned group work. But I did not follow TE that way. The teaching package also specifically mentioned group work for special lesson, I follow it and instruct the trainee teacher to follow it.

The statement states that PTII2 was unaware about the information and PTII2 has no clear idea about TB and TE.

Stakeholders were asked about the practice of collaborative approach in the classroom. AUEO said,

Teachers conduct classes traditional lecture method, but group work is convenient for both of them. Teacher gets relax from traditional lecture method by engaging the students with group work, students get chance to learn by themselves, teacher observes and give them proper instruction to do the activity or discussion.

The statement reveals that AUEO2 has moderate comprehension about collaborative approach.

Students' response in FGD

Students of FGD were asked about the classroom practice of collaborative approach. One of them replied,

Usually, teacher conduct the class through book reading and Q-A without any activity. So, we do not get the chance to do any activity in science classes with group or did not seat for group discussion.

In the statement of the student, it reveals that actually the classroom practice of collaborative approach is absent.

Information provided in TB and TE

Analyzing the primary science textbooks and teacher's edition of observed lessons, it is found that there is mentioned to discuss with classmates in TB (Figure 4.45) and instructed group activities with group discussion in TE (Figure 4.46).

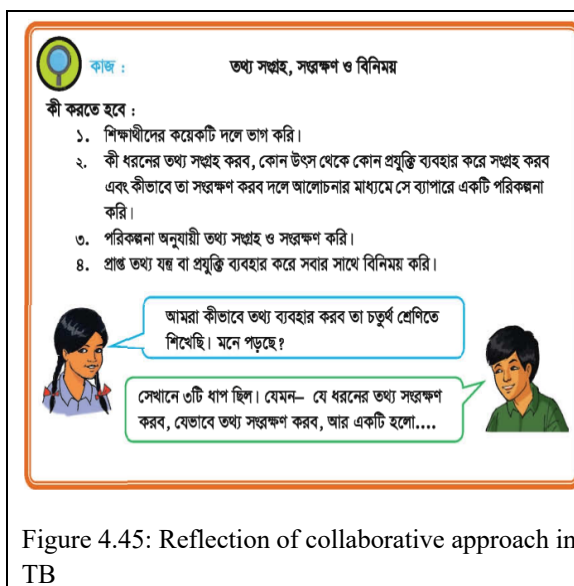


Figure 4.45: Reflection of collaborative approach in TB

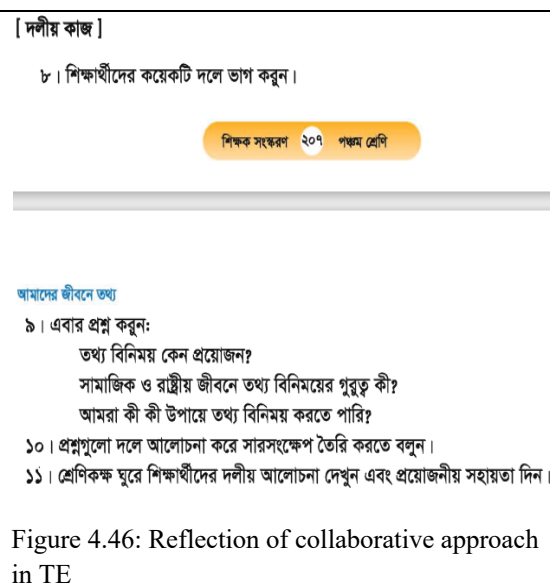


Figure 4.46: Reflection of collaborative approach in TE

The findings of collaborative approach from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table.

Table 4.55: Summary of findings about collaborative approach

Stakeholders	Stakeholders' comprehension collaborative approach			Overall comprehension	Chapter & lessons in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance Of collaborative approach	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 10 Lesson: 1 Lesson: 2	lessons-1: did not practice	Somewhat comprehend	Moderately addressed
PTI instructor	Moderately comprehend	Somewhat comprehend	Moderately comprehend	Moderately comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lessons-2: did not practice	Somewhat comprehend	Moderately addressed

Stakeholders	Stakeholders' comprehension collaborative approach			Overall comprehension	Chapter & lessons in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance Of collaborative approach	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
URC instructor	Moderately comprehend	Somewhat comprehend	Moderately comprehend	Moderately comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lessons-3: did not practice	Somewhat comprehend	Moderately addressed
AUEO	Moderately comprehend	Somewhat comprehend	Moderately comprehend	Moderately comprehend	Lesson: 3 Lesson: 4	lessons-4: did not practice	Somewhat comprehend	Moderately addressed

The findings of the table reveal that, T2 has somewhat comprehension about collaborative approach. T2 did not practice collaborative approach in the science classroom. Concerned stakeholders have moderate comprehension. The information of collaborative approach has been addressed somewhat in TB; and moderately addressed in TE.

➤ Overall remarks

The teacher has somewhat comprehension of collaborative approach, and this was reflected in T1's classroom practice. However, concerned stakeholders also have moderate comprehension; and this may be reflected in the teacher's comprehension and classroom practices. The information provided for collaborative approach in curriculum documents may also be reflected in T2 and concerned stakeholders' comprehension.

4.8.7 Illustrations (Pictures and Photographs)

Teacher's classroom practice

There are content related photographs and illustrations for activities and examples in TB. The teacher did not focus on any illustrations or photographs provided in TB and TE that way. The teacher gave only some examples of his own in two classes; that was mentioned as somewhat practice in the next table. One of teacher's classroom practices is presented in the table next.

Table 4.56: Teacher 2's classroom practice of illustrations in Grade-5, Chapter-Weather & Climate

ILO	Lesson at TE	lesson title	No. of class taken by the teacher	Given illustrations in TB	Given illustrations in TE	Activities done by the teacher
13.1.1 13.1.2	1	differences between weather and climate	3	Illustration of the map of Bangladesh showing weather of different district	No illustration	Fully follow TB provided illustration

Stakeholders' views

Stakeholders were asked about the importance of illustrations to achieve the content knowledge. AUEO2 said,

Content related illustrations and diagrams helps students to achieve content knowledge. When we can't carry teaching aids at classroom then illustrations and diagrams help teacher to conduct the class and students get idea about the content beside the text.

In the statement, AUEO2 stated the importance of illustrations as the alternative to teaching aids though the teacher does not carry teaching aid that way. However, teaching aid and illustrations are the supporting materials for text; not alternatives for each other. URCI1 has somewhat comprehension of illustrations.

In addition, stakeholders were asked about the consistency of the text and Illustrations mentioned in TE and TB. The teacher2 said,

The illustrations and diagrams provided at TB is very consistent with the content, it helps me a lot to conduct the classes.

The statement reveals that T2 have moderate comprehension about TB and TE provided information.

Participants were asked about the practice of illustration and diagram in classroom. URC instructor 2 said,

Enough illustrations and diagrams are included at TB for each lesson, these are more consistence with the content but digital color illustrstion may creat more interest to the students for science classess, students have extra interest on color picture.

The statement expresses that URCI2 has somewhat comprehension about classroom practice of illustrations as URCI2 has given emphasis on color picture after than its consistency with content.

Students' response in FGD

Students of FGD were asked about the classroom practice of illustrations and diagrams. One of them replied,

Usually, our classes conduct with reading text from textbooks, and then we follow the picture from textbooks.

The statement of the student reveals that, teacher use only the provided illustrations and photographs of TB in science classroom.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, the topics and examples of all the chapters are more or less related to our daily life. Moreover, it is found from the observed lessons that, there are content related photographs and illustrations for activities and examples in TB. Therefore, science concept related photographs are available, that helps students to understand science concept linking with real life. However, in some cases illustrations are provided rather than photographs. it might be more relevant to the content if photographs are provided. The findings of provided illustrations in documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table.

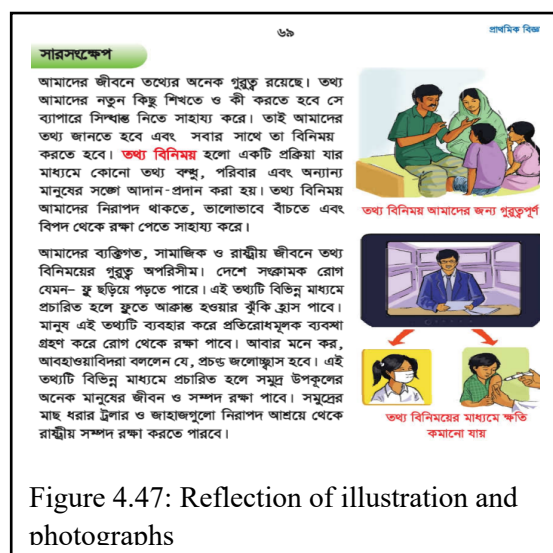


Figure 4.47: Reflection of illustration and photographs

Table 4.57: Summary of findings about illustrations

Stakeholders	Stakeholders' comprehension about illustration			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of illustration	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:10 Lesson: 1	lessons-1: somewhat practiced	Moderately addressed	Did not address
					Lesson: 2			
PTI instructor	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 3	lessons-2: somewhat practiced	Moderately addressed	Did not address
					Lessons: 4			
					Lessons: 5			
					Lessons: 6			
URC instructor	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 11 Lesson: 1	lessons-3: somewhat practiced	Moderately addressed	Did not address
					Lesson: 2			
AUEO					Lesson: 3			

Stakeholders	Stakeholders' comprehension about illustration			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of illustration	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
	Somewhat comprehend	Moderately comprehend	Somewhat comprehend				Moderately addressed	Did not address

The findings of table reveal that, T2 and concerned stakeholders have somewhat comprehension about content related illustrations. T2 somewhat focused illustrations the science classroom. Related illustrations are provided in TB; but did not provide in TE that way.

➤ Overall remarks

The teacher has somewhat comprehension of the approaches of illustrations; and this was reflected in T2's classroom practice. However, concerned stakeholders also have somewhat comprehension, and this may be reflected in the teacher's comprehension and classroom practices. The provided related illustrations in curriculum documents may also be reflected in T2 and concerned stakeholders' comprehension.

4.8.8 Scope of scientific inquiry

Teacher's classroom practice

Four lessons of T2 have been observed. The finding of one observed lesson is presented in the table where it is explored that, T2 did not engage the students with scientifically oriented question and the given activity. T2 did not practice inquiry in science classroom. The students did not get the chance to do the activity; collect data and finally formulate, evaluate or justify the explanation that way.

Table 4.58: Teacher 2's classroom practice of illustrations in Grade-5 Chapter-11

ILO	Lesson at TE	lesson title	No. of lessons taken by the teacher	Given information in TB	Given information in TE	Activities done by the teacher
13.1.1 13.1.2	1	differences between weather and climate	3	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify explanation	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify explanation	Did not engage students with activity

Stakeholders' views

Stakeholders were asked for their opinion about inquiry-based teaching. URC instructor2 said,

Students can learn by doing activities then their learning become permanent, this is inquiry-based learning.

The statement expresses the concept of URCI 2 about inquiry-based teaching, where URCI 2 stated inquiry as learning by doing the activity and this is not the inquiry. Hence, URCI 2 did not comprehend the scope of inquiry.

Stakeholders were asked about the opportunity for inquiry-based teaching mentioned in TE and TB. The teacher2 said,

TB mentioned different types of activities in each lesson for activity base class. For example, to explain high and low pressure there is an activity of heating sand and water in the TB.

In the statement, T2 mentioned the provided activities of the students for activity-based class in TB. T2 has no clear concept of inquiry-based teaching which is guided by these activities. Hence, T2 did not comprehend the scope of the inquiry.

Participants were asked about the practice of inquiry in science classroom. PTI instructor said,

I did not find the teacher doing such type of activities; did not follow the steps of inquiry like: doing experiment, data collection, explanation; and conduct the class following traditional.

In the statement it explores that PTII 2 have somewhat comprehension about inquiry.

Students' response in FGD

Students' of FGD were asked about their way of learning through inquiry. One of them stated that,

Actually, we did not get the chance to do any activity in the science classroom. Maximum time our class conducts through text reading from the textbook, write the answer and teacher asks us question to evaluate.

The statement of the student, reveals that the teacher does not focus inquiry-based teaching to conduct a lesson.

Provided information in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on inquiry-based teaching. Figure 4.48 and 4.49 presents the reflection of inquiry in TB and TE. This lesson of TB and TE presents a process of inquiry-based teaching: engaging with a scientific question, collect data, formulate explanation, evaluate explanation and justify explanation.

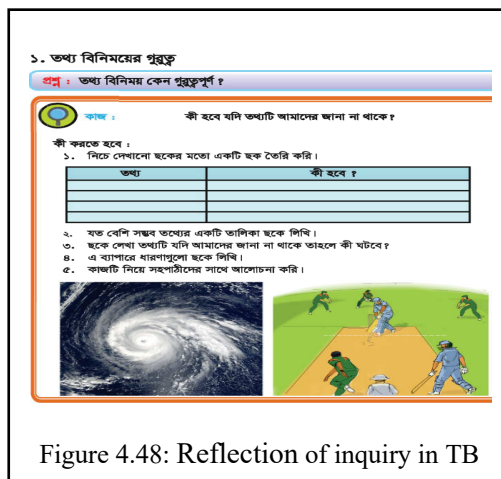


Figure 4.48: Reflection of inquiry in TB

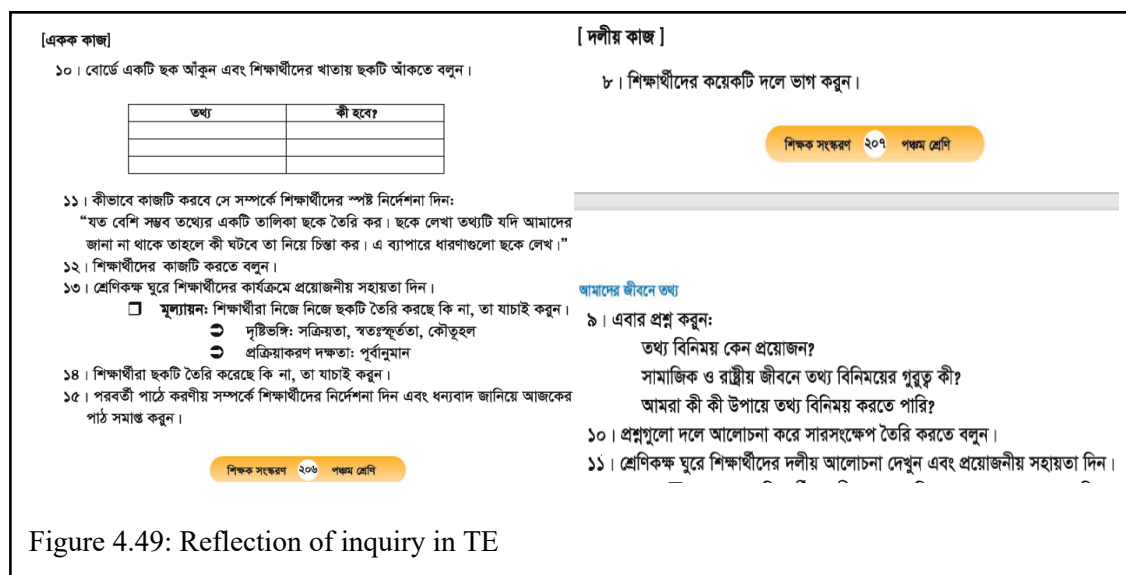


Figure 4.49: Reflection of inquiry in TE

The finding of documents analysis, lesson observations and stakeholders' comprehension regarding inquiry-based teaching are summarized in the table.

Table 4.59: Summary of findings about inquiry-based teaching

Stakeholders	Stakeholders' comprehension about inquiry			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of inquiry	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:10 Lesson: 1 Lesson: 2	lessons-1: did not practice	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 3 Lessons: 4		Somewhat addressed	Somewhat addressed

Stakeholders	Stakeholders' comprehension about inquiry			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of inquiry	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
					Lessons: 5 Lessons: 6	lessons-2: did not practice		
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lessons-3: did not practice	Somewhat addressed	Somewhat addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson: 3 Lesson: 4	lessons-4: did not practice	Somewhat addressed	Somewhat addressed

The findings of table reveal that except PTII2, T2 and concerned stakeholders did not comprehend about inquiry-based teaching. PTII2 have somewhat comprehension about inquiry-based teaching. The inquiry-based teaching approach somewhat addressed in TB and in TE.

➤ Overall remark

Teacher 2 did not comprehend of inquiry-based teaching, and this was reflected in T2's classroom practice. Concerned stakeholders also did not comprehend; and this may be reflected in the teacher's comprehension and classroom practice. The provided information in curriculum documents may also be reflected in T2 and concerned stakeholders' comprehension.

4.8.9 Lesson summary

Teacher's classroom practice

The teacher randomly instructed a few students to read the text after teaching learning activities in all the observed classes; that was mentioned as somewhat practice in the table. One of teacher's classroom practice is presented in the table next.

Table 4.60: Teacher 2's classroom practice of lesson summary in Grade-5, Chapter-10

ILO	Lesson at TE	Lesson title	Lesson taken by the teacher	Lesson summary mentioned in TB	Lesson summary mentioned in TE	Activity done by the teacher
11.1.1	1	Importance of information sharing	1	activity and lesson related text	-	
11.1.1	2				-write summary on board from students answer -explain the topic -instruct the students to read book	Read the lesson related text

ILO	Lesson at TE	Lesson title	Lesson taken by the teacher	Lesson summary mentioned in TB	Lesson summary mentioned in TE	Activity done by the teacher
					-ask them key q., receive their answer and justify -instruct them about the next lesson	

Stakeholders' views

Stakeholders were asked for their opinion about the importance of the lesson summary.

Teacher2 said,

All the lesson has lesson summary in TB and TE where the lesson related text is included, it is very important for the students, they can easily answer the question from lesson summary without getting help from guide. For example, today I told them to write the answer difference between weather and climate, they can easily get the answer from lesson summary.

In the statement, T2 mentioned lesson summary as the content related text needed for students' memorization of the content; that explores T2's somewhat comprehension of summary.

Moreover, stakeholders were asked for their opinion about the information provided in TE and TB. AUEO 2 said,

Lesson summary is the end part of the total lesson where the whole lesson is expressed shortly. I found it in TB but did not notice in TE that way.

In the statement, AUEO 2 mentioned lesson summary as the end part of the total lesson that explores AUEO 2's somewhat comprehension about summary.

Stakeholders were asked about the practice of lesson summary in classroom. PTI instructor said,

Lesson summary is placed at the end of each activity as the explanation of activity. Teacher did not engage students with activity, only read out the summary text as content.

The statement reveals PTII 2's somewhat comprehension of lesson summary.

Students' response in FGD:

Students of FGD were asked about the classroom practice of lesson summary.

One of them replied,

Our teacher instructs us to read this text again and again so that we can memorize it, we do it in groups or individually.

The statement of the student reveals that, T2 wants the students to memorize by reading the text over and over again.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, summary is placed as content text in TB, whereas TE highlighted it as the end part of teaching learning activities (TLA).

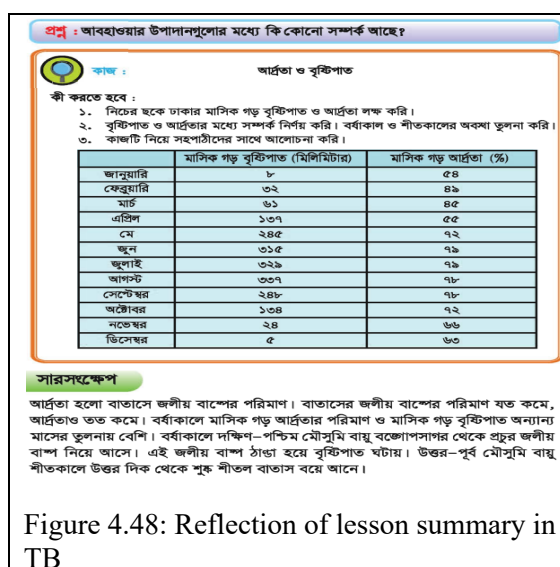


Figure 4.48: Reflection of lesson summary in TB

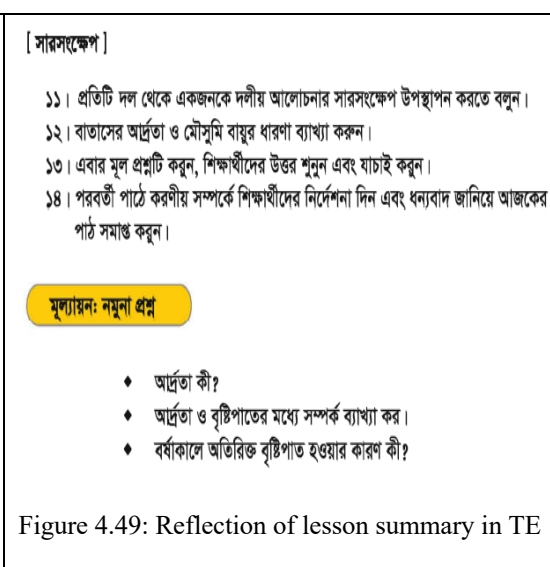


Figure 4.49: Reflection of lesson summary in TE

The findings of lesson summary from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table.

Table 4.61: Summary of findings about lesson summary

Stakeholders	Stakeholders' comprehension about lesson summary			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of lesson summary	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:10 Lesson: 1	lesson-1: somewhat practiced	Moderately addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson: 2	lesson-2: somewhat practiced	Moderately addressed	Somewhat addressed
					Lessons: 3			
					Lessons: 4			
					Lessons: 5			

Stakeholders	Stakeholders' comprehension about lesson summary			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of lesson summary	Given information in TE & TB	Way of practice in the classroom				In TB	In TE
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 6	lesson-3: somewhat practiced	Moderately addressed	Somewhat addressed
					Chapter: 11			
					Lesson: 1			
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson: 2	lesson-4: somewhat practiced	Moderately addressed	Somewhat addressed
					Lesson: 3			
					Lesson: 4			

The findings of table reveal that, T2 and concerned stakeholders have somewhat comprehension about summary. T2 somewhat focused summary in the science classroom. The information of summary moderately addressed in TB and somewhat in TE.

➤ Overall remarks

The teacher has somewhat comprehension of the summary; and this was reflected in T2's classroom practice. Concerned stakeholders also have somewhat comprehension, and this may be reflected in the teacher's comprehension and classroom practices. The provided information of lesson summary in curriculum documents may also be reflected in T2 and concerned stakeholders' comprehension.

➤ Overall remarks on the approaches of primary science textbooks and teacher's edition to facilitate inquiry-based teaching

The teacher has somewhat comprehension on most of the approaches of TB and TE. Teacher's somewhat comprehension was somewhat reflected in most of the approaches of TB and TE during classroom practices. Students also revealed that the teacher somewhat focuses most of the approaches of TB and TE in the science classroom. Concerned stakeholders' somewhat comprehension of most of the approaches of TB and TE; may be reflected in teacher's comprehension and classroom practices. Curriculum documents (TB & TE) somewhat addressed most of the identified approaches, it may be somewhat reflected in T1 and concerned stakeholders' comprehension.

4.9 Employed Learning Opportunities in Inquiry-based Teaching

4.9.1 Step-1. Learners are engaged by scientifically oriented questions

Teacher's classroom practice

It has been explored from the observed lessons that, after prior knowledge exploration or review of the previous lesson, the teacher started teaching learning activities. However, the teacher did not engage the students in scientifically oriented question. Table 4.62 shows the way of engaging students with a lesson by the teacher.

Table 4.62: Teacher 2's classroom practice of engaging students with scientifically oriented question

Grade & Chapter	ILO	Lessons in TE	Lesson taken by the teacher	Scientifically oriented question mentioned in TB and TE (Key Q.)	Teachers' activity in classroom
Grade-5, Chapter-10: 'Information in our life'	11.1.1	1	Lesson-1	Why is information sharing important?	After prior knowledge exploration, starting teaching learning activities with showing content related picture without focusing the scientifically oriented question
		2			

Stakeholders' views

In the interview, stakeholders were asked about the importance of engaging students with scientifically oriented questions. In response to the question T2 said,

Starting lesson through question is important, it helps us to know the students' knowledge about the lesson, so that we can prepare lesson accordingly.

In the statement, T2 stated the scientific question as prior knowledge exploring question that reveals, T2' did not comprehend the first steps of inquiry-based teaching.

Besides, stakeholders were asked about the Information provided in TB and TE of engaging students by scientifically oriented question. Among them the PTII2 said,

Usually, I highlight JICA provided teaching package in training session of DPED program. I instruct the trainee teacher to follow it. Beside this, I also suggest the trainee teacher to follow NCTB provided TE, I saw TE but do not follow it accordingly.

The statement expresses the unawareness of PTII2 about TB and TE, as PTII2 explained different way to not follow TB and TE that way. Therefore, PTII2 did not comprehend the information provided for inquiry-based teaching in TB and TE.

In addition, when asked about the way of engaging students with lesson in science classroom; AUEO2 said,

Firstly, the teacher tries to motivate the students through song, poem, or other activities. Then he/she shows teaching, and ask question to get students condition about the topic. It helps the teacher to conduct the class by knowing students' knowledge level.

In the statement, AUEO2 mentioned prior knowledge exploring question for engaging students into science learning that expresses, AUEO2 did not comprehend the practice of engaging students into scientifically oriented question.

Students' response in FGD

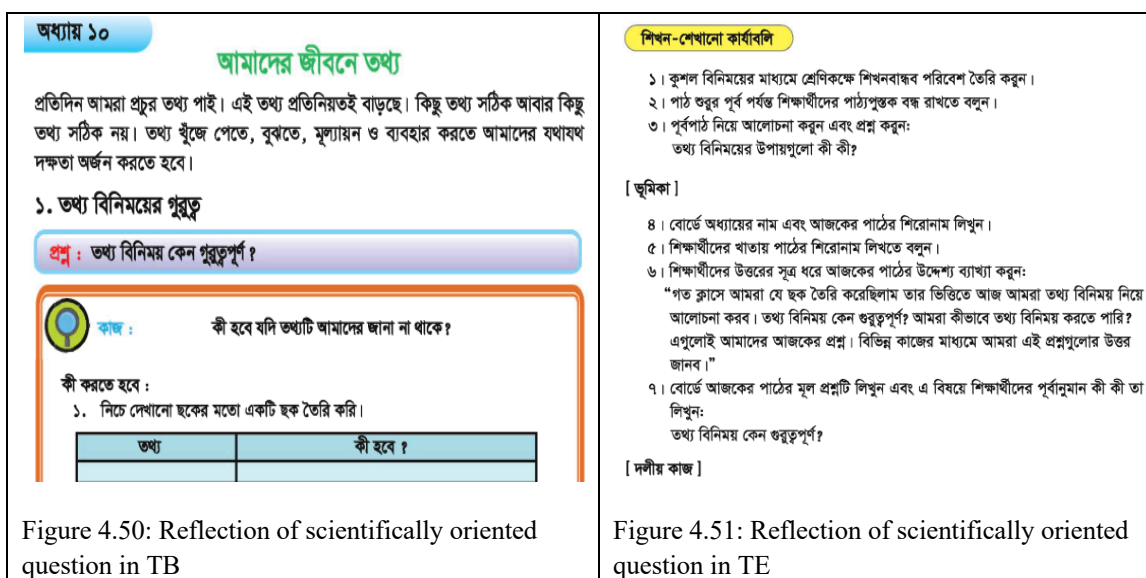
Students' of FGD were asked about the way of engaging students in lessons in science classroom. Their common response was, usually their class starts with reading text from books. One of them stated that,

Teacher instructs us to read the textbook, one of us read and we all follow; sometimes teacher start the lesson with singing song or rhymes or some questions.

The statement of the student asserts that the teacher did not engage the students with scientifically oriented question.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on key question to start a lesson. The key question is highlighted at the starting of teaching learning activities of each lesson in TB (Figure 4.50). Whereas, it is placed after prior knowledge exploring question and lesson objectives related questions in teaching learning activities in TE (Figure 4.51). Therefore, this approach is extremely addressed in TB and TE.



A summary of the findings of document analysis, lesson observation and stakeholders’ comprehension of engaging students by scientifically oriented questions are presented in the table 4.63.

Table 4.63: Summary of findings about engaging students by scientifically oriented questions

Stakeholders	Stakeholders’ comprehension about engaging students by scientifically oriented question			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher’s lesson practice	Information provided (Based on literature review)	
	Importance of engaging students	Information provided in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:10 Lesson: 1	lesson-1: did not practice	Moderately addressed	Moderately addressed
					Lesson: 2			
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lesson-2: did not practice	Moderately addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lesson-3: did not practice	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson: 3 Lesson: 4	lesson-4: did not practice	Moderately addressed	Moderately addressed

The findings of the table reveal that T2 and concerned stakeholders did not comprehend about engaging students with scientifically oriented questions. T2 did not engage students with scientifically oriented questions. The information is moderately addressed in TB and TE.

➤ **Overall remarks**

Teacher did not comprehend about engaged students by scientifically oriented questions, and this was reflected in T2's classroom practice. Concerned stakeholders also did not comprehend; and this may be reflected in the teacher's comprehension and classroom practices.

4.9.2 Step-2. Learners give priority to evidence in responding to these questions

Teacher's classroom practice

It has been explored from the observed lessons of T2 that, T2 did not give students any opportunity to do the activities and collect data. An observed lesson of T2 is shown in table 4.64 where T2 did not form groups with students and students did not get the opportunity to collect data.

Table 4.64: Teacher 2's classroom practice of giving students priority to evidence in responding to the question

Grade & Chapter	LO	Lessons mentioned in TE	Lessons taken by the teacher	Scope mentioned in TB & TE	Teachers' activity in classroom
Grade-5, Chapter-10: 'Information in our life'	11.1.1	1	Lesson-1	-make groups -give sample in each group -give proper instruction and facilitate them	instruct them to read the content related text
		2			

Stakeholders' views

Stakeholders were asked, about giving students priority to evidence in responding to the question. The URCI2 instructor said,

Sometimes teacher starts the lesson through questioning. The teacher gives the answer first, then try to get an answer from the students; because students did not know the lesson earlier and can't give an answer.

The statement explores that URCI 2 did not comprehend of giving students priority to evidence in responding to the question.

Stakeholders were asked, about the information provided in TE and TB about giving students priority to evidence in responding to the question. PTII 2 said,

May be in TB and TE where activity is provided, but I did not see or follow TB and TE it that way.

Stakeholders were asked, about the classroom practice of giving students priority to evidence in responding to the question. Teacher 2 said,

The students do not know the lesson content earlier. So, they try to give the answer and I help them. For example, when I asked them the available plants name around your house. They all named different trees. Then, I told them which is tree, which is shrub and which is herb. After that they will identify trees.

In the statement, T2 indicated that students have no prior knowledge about the content; so T2 has to state first then students can reply; explore T2 did not comprehend the classroom practice of giving students priority to evidence in responding to the question.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE) it is found that, there is scope for the students to collect evidence in responding to scientific question.

আবহাওয়া ও জলবায়ু ৭৫

২. বায়ুচাপ ও বায়ুপ্রবাহ

বায়ুচাপ

বায়ু তার ওজনের কারণে ভূপৃষ্ঠের ওপর যে চাপ প্রয়োগ করে, তা-ই বায়ুচাপ। বায়ু উচ্চচাপ অঞ্চল থেকে নিম্নচাপ অঞ্চলে প্রবাহিত হয়।

প্রশ্ন : বায়ুর উচ্চচাপ ও নিম্নচাপ সৃষ্টির কারণ কী?

কাজ : বালি ও পানি গরম করা

কী করতে হবে :

- একটি ট্রে ১ সে.মি. পুরু বালি ও অন্য একটি ট্রে ১ সে.মি গভীর পানি দ্বারা পূর্ণ করি।
- যদি সম্ভব হয়, বালি ও পানিপূর্ণ ট্রে দুইটিতে থার্মোমিটার রাখি।
- বালি ও পানির তাপমাত্রা হাত দিয়ে যাচাই করি।
- ট্রে দুইটিকে রৌদ্রোজ্জ্বল স্থানে রাখি।
- কোন ট্রে-টি দ্রুত গরম হবে অনুমান করি?
- ২০ থেকে ৩০ মিনিট পর পুনরায় হাত দিয়ে পানি ও বালির তাপমাত্রা যাচাই করি এবং পূর্বের অনুমান সঠিক কি না নিশ্চিত হই। সম্ভব হলে থার্মোমিটারের সাহায্যে বালি ও পানির তাপমাত্রা যাচাই করি।
- ট্রে দুইটিকে ঠাণ্ডা ছায়াযুক্ত স্থানে ১ ঘণ্টার মতো রেখে দিই।

Figure 4.52: Reflection of activity for the students in TB

[একক কাজ]

৮। কীভাবে কাজটি করবে সে সম্পর্কে শিক্ষার্থীদের স্পষ্ট ধারণা দিন:

“ট্রে ২টি পর্যবেক্ষণ করি। একটি ট্রে ১ সে.মি. পুরু বালি এবং অন্য একটি ট্রে ১ সে.মি. গভীর পানি দ্বারা পূর্ণ করি। যদি সম্ভব হয় বালি ও পানি পূর্ণ ট্রে দুইটিতে থার্মোমিটার রাখি অথবা বালি ও পানির তাপমাত্রা হাত দিয়ে যাচাই করি।”

৯। শিক্ষার্থীদের কাজটি করতে বলুন।

১০। প্রেক্ষাপট ঘুরে শিক্ষার্থীদের কার্যক্রমে প্রয়োজনীয় সহায়তা দিন।

মূল্যায়ন: শিক্ষার্থীরা যথাযথভাবে ট্রে দুইটি পর্যবেক্ষণ করেছে কি না এবং তাদের পর্যবেক্ষণ খাতায় লিপিবদ্ধ করেছে কি না, তা যাচাই করুন।

- দৃষ্টিভঙ্গি: সক্রিয়তা, স্বতঃস্ফূর্ততা, কৌতূহল
- প্রক্রিয়াকরণ দক্ষতা: পরিমাপ, তুলনাকরণ

[দলীয় কাজ]

১১। এবার শিক্ষার্থীদের কয়েকটি দলে ভাগ করুন।

১২। শিক্ষার্থীদের দলে আলোচনা করতে বলুন এবং তাদের মতামতের সারসংক্ষেপ করতে বলুন।

১৩। প্রেক্ষাপট ঘুরে শিক্ষার্থীদের দলীয় আলোচনা দেখুন এবং প্রয়োজনীয় সহায়তা দিন।

মূল্যায়ন: শিক্ষার্থীরা দলীয় কাজে সক্রিয়ভাবে অংশগ্রহণ করেছে কি না এবং অন্যদের সাথে সহযোগিতার ভিত্তিতে কাজ করেছে কি না তা লক্ষ রাখুন।

- দৃষ্টিভঙ্গি: মুক্ত মানসিকতা, যাচাই প্রবণতা
- প্রক্রিয়াকরণ দক্ষতা: পূর্বানুমান, সিদ্ধান্ত গ্রহণ, যোগাযোগ, পর্যবেক্ষণ

শিক্ষক সংস্করণ ২২৯ পঞ্চম রেখা

Figure 4.53: Reflection of activity for the students in TE

A summary of the findings of document analysis, lesson observation and stakeholders' comprehension of giving students priority to evidence in responding to the question are presented in the table 4.65.

Table 4.65: Summary of the findings of giving students priority to evidence in responding to the question.

Stakeholders	stakeholders' comprehension of giving students priority to evidence in responding to the question			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Giving students priority to evidence	Information provided in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:10 Lesson: 1	lesson-1: did not practice	Moderately addressed	Moderately addressed
					Lesson: 2			
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lessons: 3	lesson-2: did not practice	Moderately addressed	Moderately addressed
					Lessons: 4			
					Lessons: 5			
					Lessons: 6			
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 11 Lesson: 1	lesson-3: did not practice	Moderately addressed	Moderately addressed
					Lesson: 2			
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson: 3	lesson-4: did not practice	Moderately addressed	Moderately addressed
					Lesson: 4			

The findings of table reveal that T2 did not comprehend about giving students priority to evidence in responding to the question. However, concerned stakeholders did not comprehend. The information is moderately addressed in TB and in TE.

➤ Overall remarks

Teacher 2 and concerned stakeholders did not comprehend of giving students priority in responding to the question, and this was reflected in T2's classroom practice. The comprehension of concerned stakeholders may be reflected in the teacher's comprehension and classroom practices.

4.9.3 Step-3. Learners formulate explanations from evidence

Teacher's classroom practice

It has been explored from the observed lessons that; the teacher did not form group to do the activity. Students did not get the opportunity to do the activity and share it with others. As a result, they could not formulate any explanation of the lesson content. The table shows the teacher's classroom practice to formulate an explanation from the evidence by the students.

Table 4.66: Teacher 2's classroom practice to formulate explanations from evidence by the students

Grade & Chapter	LO	Lessons mentioned in TE	Lessons are taken by the teacher	Scope mentioned in TB to formulate explanations from evidence	Scope mentioned in TE to formulate explanations from evidence	Teachers' activity in classroom
Grade-5, Chapter-10: 'Information in our life'	11.1.1	1	Lesson-1	-	Explain to the group about sharing information, that you have written in your notebook	instruct them to read the content related text
		2				

Stakeholders' views

Stakeholders were asked, to formulate explanations from evidence from the students. The URC instructor2 said,

The teacher only focuses on reading the TB content again and again so that student can memorize the content. Students cannot answer the question properly; so explanation is not possible for them.

The statement reveals that URCI2 did not comprehend the formulation of explanations from evidence by the students, as URCI2 stated students cannot explain only give the answer.

Stakeholders were asked, about the information provided in TE and TB to formulate explanations from evidence by the students. PTI instructor2 said,

There may be information at TB and TE about teacher's role, actually I did not notice that way.

Analyzing the primary science TB and TE there found scopes for students to formulate explanations from evidence. Therefore, PTII2 did not comprehend the information provided in the documents.

Stakeholders were asked, about the classroom practice of formulating explanations from evidence by the students. Teacher 2 said,

Students cannot give an explanation of their answer as they do not know about the lesson earlier. So, I try to explain the answer. For example, why sharing of information is important? They can reply but cannot explain.

In the statement, T2 stated the reason students for not being able to explain as students have no previous idea about the lesson. Therefore, T 2 did not comprehend the classroom practice of formulating explanations.

Students' response in FGD

The students' of FGD were asked about the way to formulate explanation from evidence in science classroom. Their common response was teacher give them the answer. One of them stated,

When the teacher questions us, we try to reply; but when we cannot reply, teacher answer it and explain and instruct us to write in a notebook.

The statement of the student explores that the teacher did not give them any opportunity to do any activity, formulate an answer and explain it.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is opportunity for the students to formulate explanation of the scientific question through activity (Figures. 54 & 55).

Figure 4.54: Reflection of scope of formulate explanation in TB

Figure 4.55: Reflection of scope of formulate explanation in TE

Table 4.67 presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of formulating explanation.

Table 4.67: Summary of findings about formulating explanation from evidence by the students.

Stakeholders	Stakeholders' comprehension of formulating explanation from evidence by the students			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	Formulating explanation from evidence	Information provided in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 10 Lesson: 1 Lesson: 2	lesson-1: did not practice	Moderately addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lesson-2: did not practice	Moderately addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lesson-3: did not practice	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson: 3	lesson-4: did not practice	Moderately addressed	Moderately addressed

The findings of table reveal that, T2 and concerned stakeholders did not comprehend about formulating explanation from evidence by the students. T2 did not engage students to formulate explanation from evidence. The information is moderately addressed in TB and in TE.

➤ Overall remark

The teacher did not comprehend of formulating the explanation from evidence by the students; and this was reflected in T2's classroom practice. The comprehension of concerned stakeholders may be reflected in T2's comprehension and classroom practices.

4.9.4 step-4. Learners evaluate their explanations in light of alternative explanations

Teacher's classroom practice

It has been explored from the observed lessons that, the teacher filled the provided blank table on the board by own self, and directed the students to write in their notebooks. After that instruct them to read the book. Students did not get the opportunity to formulate and evaluate the explanation in light of alternative interpretations. A lesson exercise of T2 is shown in table.

Table 4.68: Teacher 2's classroom practice of evaluating learners explanation in light of alternative explanation

Grade & Chapter	LO	Lessons mentioned in TE	Lessons are taken by the teacher	Scope mentioned in TB to evaluate explanations in light of alternative explanations	Scope mentioned in TE to evaluate explanations in light of alternative explanations	Teachers' activity in classroom
Grade-5, Chapter-10: 'Information in our life'	11.1.1	1	Lesson-1	Content related text	-instruct the students to open the book -instruct them to read the content related text	instruct them to read the content related text
		2				

Stakeholders' views

To know about this, stakeholders were asked, about providing students opportunity to evaluate their explanations in light of alternative explanations. The PTI instructor2 said,

The teacher tries to get the answer from other students after one's reply, but students are not so much responsive to that, the teacher instructs them to read the book for an answer.

The statement reveals that PTII 2 did not comprehend about providing students the opportunity to evaluate their explanations in light of alternative explanations.

Stakeholders were asked, about the information providing students opportunity to evaluate their explanations in light of alternative explanations. URC instructor2 said,

More or less TB and TE provided the information or instruction for the teacher- what they have to do in each step of teaching learning but our teacher do not follow it that way.

The statement reveals that URCI2 did not comprehend of the information provided in curriculum documents.

Stakeholders were asked, about the classroom practice of giving opportunity to evaluate their explanations in light of alternative explanations. URC instructor2 said,

Teacher do not practice it in classroom. They ask question to the students, 2-3 students can reply or not, teacher do not give more attention on assessment, only reading is the main focus.

The statement reveals that URCI 2 did not comprehend the classroom practice of giving opportunity to evaluate their explanations in light of alternative explanations.

Students' response in FGD

The students' of FGD were asked of the providing opportunities to evaluate their explanations in light of alternative explanations. Their common response was teacher give them the answer. One of them stated,

When the teacher questions us, we try to reply; but when we cannot reply, the teacher answers it and explain and instruct us to write on a notebook.

In the statement of a student, it is asserted that the teacher did not give then any opportunity to do any activity, formulate answers and explanation.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is given opportunities for the students to evaluate their explanation in light of alternative explanation (Figure 4.56 & 4.57).

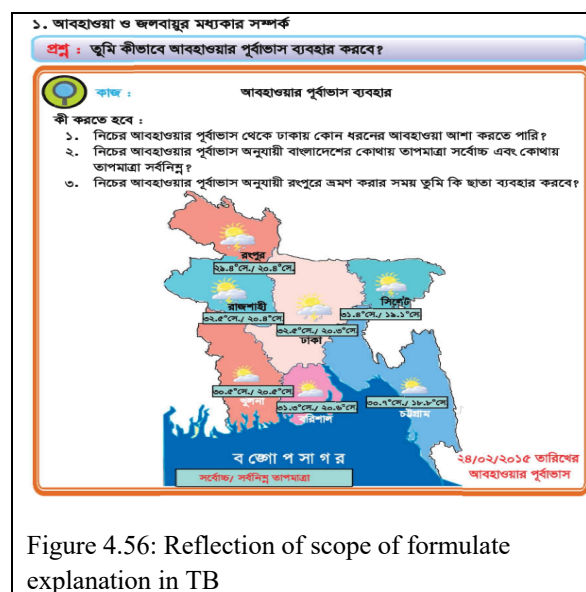


Figure 4.56: Reflection of scope of formulate explanation in TB

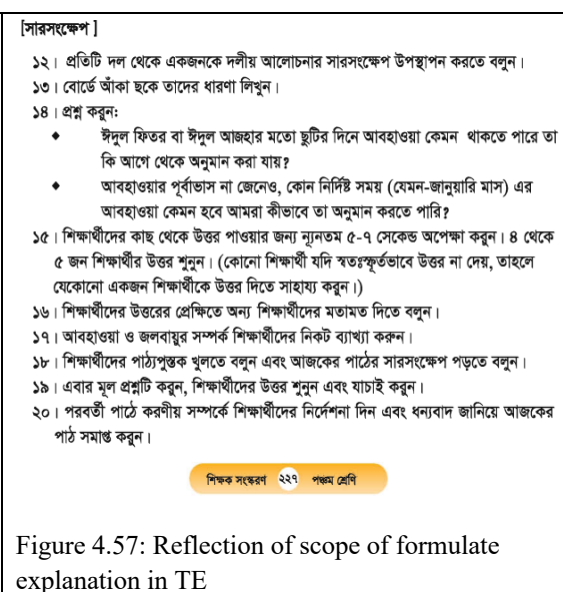


Figure 4.57: Reflection of scope of formulate explanation in TE

Table 4.69 presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of giving opportunity to evaluate their explanations in light of alternative explanations.

Table 4.69: Summary of findings about giving opportunity to evaluate their explanations in light of alternative explanations

Stakeholders	Participants view about students' communication with each other's and justify their explanations			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	About formulating explanation from evidence	Information provided in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 10 Lesson: 1 Lesson: 2	lesson-1: did not practice	Somewhat addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lesson-2: did not practice	Somewhat addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lesson-3: did not practice	Somewhat addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson: 3	lesson-4: did not practice	Somewhat addressed	Moderately addressed

The findings of the table reveal that T 2 and concerned stakeholders did not comprehend about giving an opportunity to evaluate students' explanations in light of alternative explanations. T2 did not give an opportunity to evaluate students' explanations in light of alternative explanations. The information is somewhat addressed in TB and moderately addressed in TE.

➤ Overall remark

The teacher did not comprehend of giving the opportunity to evaluate students' explanations in light of alternative explanations, and this was reflected in T2's classroom practice. Concerned stakeholders also did not comprehend, which may be reflected in the teacher's comprehension and classroom practices.

4.9.5 Step-5. Learners communicate and justify their explanations

Teacher's classroom practice

It has been explored from the observed lessons that, T2 did not form groups or directs the student' to form groups for group discussion. Therefore, students do not have the opportunity to communicate with each other and justify the explanation. A lesson exercise of T2 is shown in Table.

Table 4.70: Teacher 2's classroom practice about students communicating and justifying their explanations

Grade & Chapter	LO	Lessons mentioned in TE	Lessons are taken by the teacher	Scope mentioned in TB to communicate with others and justify students' explanation	Scope mentioned in TE to communicate with others and justify students' explanation	Teachers' activity in classroom
Grade-5, Chapter-10: 'Information in our life'	11.1.1	1	Lesson-1	group discussion	-group discussion, -filled the table by students' group discussion answer	did not form group
		2				

Stakeholder' views

Stakeholders were asked about the students' communication with each other's and justify their explanations. The PTI instructor 2 said,

The teacher gets the answer from several students and told them to follow others answer and finally instruct them to see TB content.

The statement explores that, PTII 2 stated that the teacher has given the opportunity to evaluate learners' answer with others but this is not the inquiry approach; that reveals PTII 2 has somewhat comprehension.

Stakeholders were asked about the information provided in TE and TB about the students' communication with each other's and justify their explanations. AUEO2 said,

I did not find that type of any instruction in TB and do not follow TE that way.

The statement explores that, AUEO2 was unaware of curriculum documents and did not comprehend the approaches of inquiry.

Stakeholders were asked about the classroom practice of students' communication with each other's and justify their explanations. Teacher2 said,

I told students to follow other's answers, then directs them to read the book and match the answer with TB content, they can't give their justification that way, so I receive answers from several students so that they can memorize it.

The statement reveals that T 2 did not comprehend of classroom practice of students' communication with each other's and justify their explanations.

Students' response in FGD

The students' of FGD were asked about providing opportunities to communicate and justify their explanations. Students' common response was teacher give them the answer and instruct them to read it from the book. One of them stated that

When we cannot answer, the teacher gives the answer and explain it; and instruct us to read the text from books.

In the statement of the student, it explores that the teacher did not give them any opportunity to communicate and justify their explanations.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is given opportunities for the students to communicate with others and justify their explanation through group discussion (Figure 4.58 & 4.59).

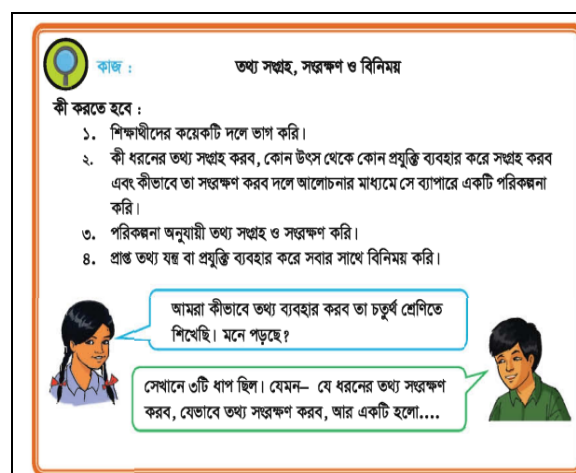


Figure 4.58: Students' communication with others and justify their explanation

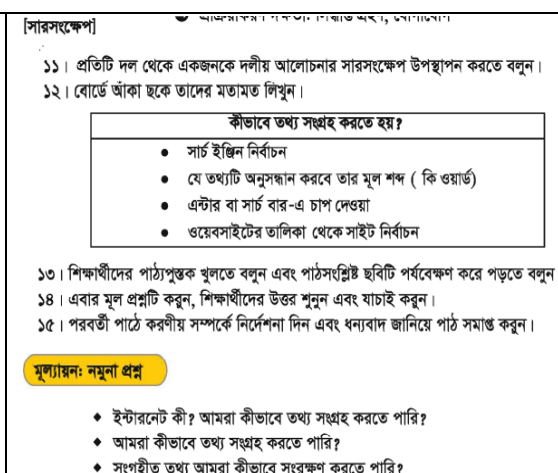


Figure 4.59: Students' communication with others and justify their explanation

The table 4.71 presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of students' communication with each other's and justify their explanations

Table 4.71: Overall findings about students' communication with each other's and justify their explanations

Stakeholders	Participants view about students' communication with each other's and justify their explanations			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)	
	About evaluate their explanations	Information provided in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:10 Lesson: 1 Lesson: 2	lesson-1: did not practice	Somewhat addressed	Somewhat addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lessons: 3 Lessons: 4 Lessons: 5 Lessons: 6	lesson-2: did not practice	Somewhat addressed	Somewhat addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lesson-3: did not practice	Somewhat addressed	Somewhat addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson: 3	lesson-4: did not practice	Somewhat addressed	Somewhat addressed

The findings of table reveal that, T2 and concerned stakeholders did not comprehend about learners' communication and justify their explanations. T2 did not give opportunity to learners' for communicating with each other's and justify their explanations. The information is somewhat addressed in TB and TE.

➤ Overall remarks

The teacher did not comprehend of giving the opportunity to learners communicate with each other's and justified their explanations, and this was reflected in T2's classroom practice. Concerned stakeholders also did not comprehend, and this may be reflected in the teacher's comprehension and classroom practices.

➤ Overall remarks on given learning opportunities provided for inquiry-based teaching

The teacher 2 did not comprehend inquiry approaches. The teacher 2's comprehension of inquiry was reflected in the classroom as teachers did not practice inquiry based teaching in the science classroom. Students also revealed that teachers did not focus on inquiry approaches in the science classroom. Concerned stakeholders did not comprehend the inquiry approaches that may reflected in teacher's comprehension and classroom practices. Mostly, curriculum documents (TB & TE) moderately addressed the inquiry approaches.

4.10 Comprehension of Practiced Assessment Methods to Assess ILOs

4.10.1 Formative assessment: areas and tools

The following section presents the results about the comprehension of practiced assessment methods: summative and formative through documents analysis, lesson observation and interviews.

Provided information in Text Books, Teacher's Edition and Assessment Guide

It is clearly instructed at the start of the teacher's edition that, "conduct formative assessment of the student during and end of the lesson, and keep record according to assessment guide". However, the next table presents the data from documents analysis and lesson observations of assessment areas (cognitive knowledge, science process skills; scientific attitude and values) and assessment tools (Oral and written). Analyzing the primary science textbooks (TB), teacher's editions (TE) and assessment guide (AG) it is found that, the information provided for lesson-1 moderately addressed in TE following the AG instruction but did not address in TB that way.

Table 4.72: Information provided for formative assessment areas and assessment tools: Grade-5; Chapter-10 'Information in our life'; ILO no-11.1.1 Lessons-1

Selected assessment areas, sub-areas and tools in Assessment Guide			Assessment areas focused at TE	Assessment tools mentioned at TE	Assessment areas focused at TB	Assessment tools mentioned at TB	Assessment areas focused by the teacher	Assessment tools practiced by the teacher
areas	sub-areas	tools						
cognitive Knowledge	remembering	*oral assessment checklist *written questions	knowledge	questions	knowledge	questions	knowledge	oral questions
	understand							
	application							
	higher order learning							
science process skills	observation	*observation checklist *oral checklist *written questions	prediction	Verify students' classwork	Absent	Absent		
	measurement			Verify students' answer				
	classification							
	prediction							
	decision making							
	experiment							
	communication							
scientific attitude and values	interest	observation checklist	interest	Verify students' active participation in group discussion	positive attitude			
	curiosity		curiosity					
	open mindedness							
	curious on verification							

Teacher's classroom practice

The table reveals that T2 focused only on knowledge for assessment through oral questions in the lesson 1. T2 did not focus on any scientific skills and attitude, and did not focus on any other tools which are also mentioned in TE. Therefore, T2 somewhat practiced the mentioned assessment areas and tools.

Stakeholder' views about formative assessment method: areas and tools

Formative assessment areas

Here, stakeholders were asked about the formative assessment focus areas during classroom assessment. The URC instructor 2 said,

The classroom assessment focus is learning outcome. I always try to assess students' knowledge level in classroom through oral Q-A, understand and application also come.

In the statement, URCI 2 stated the focus areas for of formative assessment where two basic focuses for science learning: skill and attitude are absent. This statement indicated that URCI 2 has somewhat comprehension about the focus areas for formative assessment.

To know stakeholders' knowledge about the information provided in documents, they were asked about the given assessment areas in TE and TB. URCI2 said,

Due to my workload, I couldn't concentrate on each subject in TB and TE deeply. There are some questions for the teacher to assess the students.

The explanation reveals URCI2's unawareness about the information provided in the documents, as URCI2 did not follow TE and TB, and did not understand that way.

Stakeholders were asked about teacher's classroom practice of formative assessment areas. AUEO2 said,

Most of the teacher assess students' knowledge level, they can't focus in understand and application level. Students cannot read, so what will we assess.

In the explanation it reveals that among the assessment focus areas mentioned in the teacher's addition and the assessment guide, AUEO 2 mentions only knowledge. The

important two other assessment areas of science learning are absent in the statement, which reveals that AUEO 2 has somewhat comprehension of the assessment focus areas.

Formative assessment tools

Stakeholders were asked about the scope of assessment tools in the provided activities of TE and TB. The teacher2 said,

I have many classes in a day with different grades, so become busy with classes and other school-based activities; I could not get chance to see the TE and TB that way, but I follow TB for classroom assessment.

Here, the unawareness of T2 is explored in the above statement, as T2 only follows TB for classroom assessment. However, instructions for classroom assessment are clearly provided in TE and AG. Hence, T2 has somewhat comprehension of classroom assessment tools.

Stakeholders were asked about the assessment tools practice in classroom. PTI instructor2 said,

Classroom assessment is two types: oral and written, teachers usually use oral questions for assessment and rarely use written questions.

The statement reveals PTII2's somewhat comprehension of classroom assessment. Observation is a very much important assessment tool for assessing scientific attitude in science teaching learning activities that were absent in PTII2's statement.

A summary finding of stakeholders' comprehension about formative assessment method is presented in the table next.

Table 4.73: Stakeholders' comprehension about formative assessment methods

Stakeholders' comprehension about formative assessment: areas and tools						Overall comprehension of formative assessment areas and tools
Stakeholders	Areas of formative assessment	Information of formative assessment areas in TB & TE	Views about classroom practice of assessment areas	Information of formative assessment tools in TB & TE	Views about classroom practice of assessment tools	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table reveals that the teacher and concerned stakeholders have somewhat comprehension of the areas and tools of formative assessment. However, they also have somewhat comprehension of TB and TE provided information. Moreover, the teacher and concerned stakeholders have somewhat comprehension about classroom practice of formative assessment areas and tools.

The summary of findings about the information provided by TB and TE; and the level of T2's practiced classroom assessment methods is shown in the next table.

Table 4.74: Summary of findings of formative assessment methods

Stakeholders	Stakeholders' comprehension of formative assessment methods			Overall comprehension	Chapter & Lesson in Grade Five	Teacher's lesson practice	Information provided (Based on literature review)		
	About areas of formative assessment	About given Information in TB & TE	About way of classroom assessment				In TB	In TE	In AG
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 10 Lesson: 1 Lesson: 2	lesson-1: somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lessons: 3	lesson-2: somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
					Lessons: 4				
					Lessons: 5				
					Lessons: 6				
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 11 Lesson: 1 Lesson: 2	lesson-3: somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson: 3	lesson-4: somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed

The table reflects that the teacher and concerned stakeholders have somewhat comprehension about formative assessment methods. It also explores that, T2 somewhat practiced formative assessment, as T2 did not focus on assessment areas and did not practice assessment tools as such in the classroom. The information of formative assessment areas and assessment tools are somewhat addressed in AG, TE, and TB.

➤ Overall remarks

The teacher has somewhat comprehension of formative assessment methods, and this was reflected in T2's classroom practice. Concerned stakeholders also have somewhat comprehension, and this may be reflected in the teacher's comprehension and classroom practices. Curriculum documents addressed somewhat, and this may also be reflected in the teacher and concerned stakeholders' comprehension and teacher's classroom practice.

4.10.2 Summative assessment: areas and tools

Stakeholder' views about summative assessment

To know stakeholders' view they were asked about the areas of summative assessment.

Teacher2 said,

Usually, experienced master trainers do it centrally in Upazila centrally; I do not get a chance to develop questions; I do assess the exam sheets following the areas and numbers mentioned in question.

The statement reveals that T2 did not get the opportunity to develop summative assessment questions and only assess the following questions. Therefore, T2 has somewhat comprehension of the areas of summative assessment.

In response to a question asked about the instructions given in the documents (TE, TB & AG) specifying the areas of summative assessment areas, URC instructor2 replied,

Questions are provided in the end of each chapter in TB and TE; but no other instruction was provided regarding summative assessment; teachers follow NAPE provided marking scheme to assess the answer script.

The statement reveals that URCI 2 was unaware of the assessment instruction and has no idea about the assessment guide. URCI 2 also stated marking scheme for assessment instruction. URCI 2 did not know the instruction provided in documents for summative assessment.

Stakeholders were asked about the development of summative assessment question. AUEO2 replied,

Upazila consists of a committee with expert persons to prepare questions centrally; they follow the marking scheme provided by NAPE; all the schools of the Upazila assess students with the questions. The teacher assesses the answer sheet following a marking scheme.

The statement reveals that AUEO 2 did not engage in developing question but have somewhat comprehension of summative assessment.

A summary finding of stakeholders' comprehension of the summative assessment method is presented in the next table, where areas of assessment, the information provided in documents and the development process of assessment questions are included.

Table 4.75: Stakeholders' comprehension about summative assessment method

Stakeholders' comprehension about summative assessment method				Overall comprehension
Participants	Focusing areas of assessment	Information provided at documents about assessment areas	Development of summative assessment question	
teacher	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table reflects that the teacher and concerned stakeholders have moderate comprehension about the focusing areas of summative assessment. Moreover, they have somewhat comprehension of the provided information in the documents and question development. Therefore, the stakeholders have somewhat comprehension of summative assessment method.

Practiced summative assessment question in the school

The collected summative assessment question is analyzed focusing on areas and tools, and the findings are presented in the next table.

Table 4.76: Areas and tools of the practiced summative assessment areas and tools

Types of questions	Cognitive knowledge								Total no of Q.	Total number of Q.
	Remembering		Understanding		Applying		Higher order learning			
	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.		
Short Q.	2	2×2=4	2	2×2=4	1	1×2=2	-	-	10	10
Fill in the blanks	10	10×1=10	-	-	-	-	-	-	10	10
Matching	5	5×2=10	-	-	-	-	-	-	5	10
Narrative Q.	5	5×10=50	-	-	2	2×6=12	1	1×8=8	8	70
Total number	-	74 (74%)	-	4 (4%)	-	14 (14%)	-	8 (8%)	33	100

The table reveals that the practiced summative assessment question covered maximum of almost 74% of questions focusing on remembering whereas, higher order thinking covered only almost 8%. There are found an anomaly in the question, where 5 questions within 33

were repeated. However, there is no marks distribution for a fraction of questions in the narrative part, which can confuse teachers to mark against each question.

The findings of the analyzed summative assessment question and the information provided by NCTB and the assessment guide (AG) for preparing summative assessment questions are presented in the next table.

Table 4.77: Provided areas and percentage of summative assessment method

Areas and percentage of knowledge for summative assessment			
Areas of knowledge	% of practiced questions	proposed % from NCTB	Proposed % from assessment guide
remembering	74	20	30
understanding	4	30	30
applying	14	30	30
HOT	8	20	10

The table reveals that the maximum % (74) question was from remembering, and the minimum % (8) question was from higher order thinking (HOT) in practiced summative question. However, there is a big gap in remembering (74%) and understanding (4%) areas in the analyzed question. NCTB suggested 20% and assessment guide (AG) suggested 30% questions from remembering. In the case of understanding, both NCTB and AG suggested 30 % of questions. Therefore, the practiced summative question did not follow the provided instructions for preparing questions.

➤ Overall remarks

The teacher and concerned stakeholders did not have the opportunity to be involved in the summative assessment question development. However, they were somewhat comprehend about the summative assessment method. The practiced summative assessment question did not follow the instruction given in the documents, and this may be reflected in the teacher and concerned stakeholders' comprehension.

4.11 Comprehension about the Extent of Students' Achievement of ILOs

4.11.1 The extent of ILOs achievement by formative assessment

Stakeholders view about the extent of ILOs achievement by formative assessment

To know the stakeholders' view, they were asked 'How to understand the extent of students

achieved ILO during conducting lesson. The URC instructor2 said,

Teacher asks them questions after finish lesson, their answering approach helps teachers to understand how much students' LO have been achieved.

In the statement, URCI 2 stated that formative assessment has been conducted at the end of the lesson through questioning, and the extent of achieving ILO is understand by the students answering approach. This statement reveals URCI2 has somewhat comprehension.

To know stakeholders' view, they were asked about the information provided in AG, TB and TE to assess the extent of achieving the ILOs through formative assessment. in response the AUEO2 said,

Teachers are instructed to assess the students with the questions provided in TB and TE or they create their own questions and evaluate the students in class. We have also formatted the structure for classroom assessment.

In the statement of AUEO2 it explores that, AUEO 2 aware of the provided information in TB, TE and the provided formatted structure for formative assessment. However, AUEO2 was unaware about subject based assessment guide. Therefore, AUEO2 were moderate comprehend about the information provided in documents. To know the classroom practice, stakeholders were asked about the practice to assess the extent of students' achievement of the ILOs through formative assessment. Teacher2 stated,

Students' achievement can be known by Q-A in class time focusing knowledge, understand and application. We do not have any system to give them marks for formative assessment.

In the statement, T2 explained the way of assessing the extent to achieve the ILOs during conducting lessons without following any given instruction or format. This explanation revealed the unawareness of T2, from which it can be understood that T2 was somewhat comprehend about formative assessment.

Table 4.78: Summary of the findings of stakeholders' comprehension about the extent of formative assessment.

Stakeholders	Stakeholders view about the extent of achieving the ILOs through formative assessment			overall comprehension about the extent of ILO achievement through formative assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE about formative assessment extent	Practice of the extent of ILO achievement	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Moderate comprehend	Moderate comprehend	Moderate comprehend
AUEO	Moderate comprehend	Moderate comprehend	Moderate comprehend	Moderate comprehend

From the table it states that the teacher and one concerned stakeholder have somewhat comprehension of the extent of students' achievement of ILOs by formative assessment. However, two concerned stakeholders have moderate comprehension.

➤ Overall remarks on assessment methods

The teacher and concerned stakeholder have somewhat comprehend of assessment methods. Stakeholders' comprehension may be reflected in teachers' comprehension and practice.

4.11.2 The extent of students' ILOs achievement by summative assessment

Stakeholder's view

Stakeholders were asked 'How to understand the extent of the students ILOs achievement through summative assessment? The URCI2 said,

Summative assessment is the assessment of students at the last stage of a level focusing LO. Our teacher could not get chance to develop summative question but assess the answer script following the number provided in the question paper against each question or marking skim and understand students' achievement.

The statement reveals URCI2's moderate comprehension of the extent of students ILO achievement by summative assessment.

Stakeholders were asked about the information provided in AG, TB and TE to assess the extent of students learning for achieving the ILOs. AUEO2 said,

Sample questions are provided in the end of each chapter in TB and TE for summative assessment. Teacher assesses the answer script following the marking skim provided by NAPE or the given number against each question in the question paper.

The statement reveals AUEO2's moderate comprehension about the provided information in curriculum documents.

Stakeholders were asked about the practice of achieving the extent of ILOs through summative assessment. The teacher² said,

I follow number against each question to assess. For example, knowledge-based answer is for one number, understand based answer is for 2 number and application based answer is for 3/4 number. If the students can give answer accurately, gets full marks; if can't then get less marks.

The statement explores the summative assessment process of T2, where T2 follows the instruction given in question to assess the answer script. Hence, T2 has somewhat comprehension.

A summary of the findings of stakeholders' comprehension about the extent of students' achievement of ILOs by summative assessment is shown in the next table.

Table 4.79: Summary of findings of stakeholders' comprehension about the extent of students' achievement of ILOs by summative assessment

Stakeholders	Stakeholders view about the extent of students ILO achievement by summative assessment			overall comprehension about the extent of students ILO achievement by summative assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE	Teacher's assessment system	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Somewhat comprehend	Moderate comprehend	Moderate comprehend
AUEO	Moderate comprehend	Somewhat comprehend	Moderate comprehend	Moderate comprehend

From the table it states that the teacher and one concerned stakeholder have somewhat comprehension of the extent of students' achievement of ILOs by summative assessment. However, two concerned stakeholders have moderate comprehension.

➤ Overall remarks

The teacher has somewhat comprehension of the extent of students' achievement of ILOs by both the formative and summative assessment. Concerned stakeholders have somewhat to moderate comprehension in both the assessment and this may be reflected in teachers' comprehension and practices.

➤ **Overall remarks on the extent of students' achievement of ILOs**

Teacher has somewhat comprehension about the extent of students' achievement of ILOs. Mostly, concerned stakeholders have moderate comprehension; that may be reflected in teachers' comprehension and practices.

4.12 Challenges to Practice Inquiry in the Science Classroom

Challenges of practicing inquiry in the science classroom

This study finds the most significant challenges from case A to the successful implementation of inquiry-based teaching in teacher and concerned stakeholders' interview sessions and these are presented in the next.

1. Professional development outcomes

Research has shown that short-term training of teachers on inquiry instruction did not changes teachers' practice (Yoon et al., 2007). T2 said,

I did not get a curriculum or any subject-based training. I get only PTI training and we were large in number, so did not get the chance to have practical experiences with our teachers, though they were sincere and cooperative, I have a gap in my teaching-learning strategies.

URCI2 said,

Although all the teachers get PTI training after that, they need specific training on subjects and curriculum to know the approaches to teaching-learning. It must be run for the year-round program so that they are in practice and monitoring.

The statements reveal that year-round training for their professional development is helpful for inquiry teaching.

2. Commitment to inquiry

The commitment to work towards the implementation of inquiry-based teaching as an approach to science learning. In URCI2's words,

Teachers are not that dedicated to engaging students in hands-on activities, they prefer the traditional way to conduct lessons. Along with teachers' interests, school management, resources, and environment and also a big concern.

PTI instructor2 said,

Teacher has to be strategic and interested to conduct a doing activity-based class; though it needs more time and proper instruction, the teacher did not get interested in the class and conducted the class in a traditional way

The statements disclose that commitment to inquiry as an issue of introducing inquiry-based lessons. They also added, here needs to be a whole school commitment to the successful implementation of activity base classes with school management of human and physical resources, like human capacity, space, and equipment.

3. Resources available at the schools: Human and physical

Although science recognizes as a core subject in the primary curriculum, many primary school teachers lack the confidence to teach science lessons because they are not subject specialists. The availability of resources can boost teachers' confidence. T2 claimed,

I have to conduct lessons in different subjects of different primary grades in a day. Therefore, I can't concentrate on a subject to conduct with a proper plan following TE and TB. However, I did not get subject-based training to get ready myself. Moreover, it is tuff for me to engage a large number of students with activities.

PTI instructor said,

Teachers need an activity-based environment for activity-based classes; the resources, space, and collegial support all influence them not to do activity-based classes.

The statements explore that subject knowledge and availability of resources cause problems to practice inquiry in the science classroom.

4. The difficulty of assessment

Summative assessment may not be suitable for inquiry-based learning as inquiry skills are not content-bound. So, paper and pencil tests create challenges to the implementation of inquiry science as it assesses only knowledge and cognitive processing. URCI2 stated,

Summative assessment cannot assess students' achievement of activity-based science learning, we have to think about our assessment system to assess students' activity skills.

AUEO2 asserted,

Teacher only asks question after the compression of a lesson in the class and try to understand how much students can memorize their lesson. Students are assessed by the final written exam.; how could the teacher asses the activity-based class.

The statements reveals that the difficulty of assessment systems creates to assess students' inquiry-based learning.

5. Classroom management

Classroom assessment is a concern for inquiry learning. Stakeholders mentioned the challenges of monitoring students' performance, keeping students on task, and managing group work during lesson conduction. T2 claimed,

Our students are comparatively more in number than our classroom space. We do not get them the facilities to do activities in class, our classroom seating arrangement is also a problem to do activities in the class.

PTII2 said,

Students' achievement of inquiry-based learning can be assessed during the investigation process through a formative assessment where some skills with knowledge are also focused. Summative assessment is not aligned with inquiry-based learning properly.

The statements reveal that teachers faced difficulty to practice inquiry because of classroom management.

6. Curriculum design and infrastructure

Curriculum design and the infrastructure of the schools need to align for implementing curriculum instruction. The physical and human resources of the school, seating arrangement, and sufficient place all are important to implement curriculum instruction.

URC instructor2 said,

Most cases, our schools have no sufficient space, resources, and other needed facilities. So, teachers do not get interested to implement activity-based class though it is instructed in the curriculum.

AUEO1 asserted,

Our teacher cannot connect curriculum instruction with classroom activities. The infrastructure of schools does not support curriculum

instruction. The teacher does not get interested to do an activity, and does not get ready to manage the activity class.

The statements reveal that teachers faced difficulty to practice inquiry because of curriculum design and institutes infrastructure.

7. Lack of motivation

Inquiry requires a higher level of motivation for both teachers and students. If they are not sufficiently motivated, they either lose their interest to participate or participate in a disengaged way in inquiry activities, and that does not support learning. Teacher2 said,

I do not understand inquiry so did not get interested to do inquiry-based classes in the classroom.

URCI2 said,

Teachers' lack of interest in engaging students with the investigation also makes students demotivated about the investigation. Investigation requires a higher level of motivation than traditional learning.

The statements reveal a lack of motivation as an obstacle to inquiry.

8. Accessibility of investigating techniques

Scientific investigation requires a level of precision and care that are not needed for students' other learning. PTII2 said,

Teachers play an important role in doing an investigation, but the needed tools to be accessible for the learners and their prior experiences is also a matter of concern for conducting investigation.

AUEO2 asserted,

Students of elementary level are too young to do activities. So the needed tools must be easy for them to handle.

The statements reveal students' accessibility of investigation technique as an obstacle for inquiry.

Case study C

In this case, the teacher³ was from an urban area. Other concerned stakeholders were: PTI instructor, URC instructor and AUEO; who are engaged in teacher training, supervision and monitoring. Some students of teacher³ have also participated in FGD.

The following section explores stakeholders' comprehension of intended learning outcomes through semi-structured interview. Here, stakeholders' responses explore their level of comprehension about the focus of ILOs.

4.13 Stakeholders' Comprehension about the Focus of ILOs

Teacher's classroom practice

It has been explored from the four observed lessons that, the teacher focused only knowledge level of ILO the other two focuses: skill and attitude are absent. The next table presents the way of starting a lesson by teacher 3.

Table 4.80: Teacher 3's classroom practice about the focus of ILOs in Grade-4, Chapter-6, 'Matter'

No of ILO	ILO in TE	Lessons in TE	Lesson title	Lessons taken by teacher	Teacher's focus on ILO
16.1.1	Will be able to describe that matter has weight.	1	Properties of matter: volume	Lesson-1	Focused only knowledge
16.1.2	Will be able to explain that matter takes up space.	2			

Stakeholders' views

In response to the question 'What is the intended learning outcome-explain with an example.' the T3 replied,

The focus of the lesson that students will learn from the lesson is the leaning outcome. For example, in my past class the LO is-will be able to explain that matter takes up space, students have to understand the matter and I conduct the class following TB and TE with the given activity to understand them.

In the statement, T3 explained ILO as students' achievement of knowing and identifying something from content. However, the other two important focuses of ILOs are skill and

attitude, are totally absent in the explanation; which reveals the teacher's somewhat comprehension of ILO.

In the interview, when asked 'What are the importance of ILO focus-explain with example?' the PTI Instructor3 stated,

The focus of LO is very important for students and the teacher also. The focuses are knowledge, understand and application. It helps teacher to understand what she/he has to focus in the class and what students have to achieve.

In the statement, PTII 3 stated the importance of the focus of ILOs for guiding the teachers, and the ILO focus is knowledge, understand and application, that reveals dearth of information of PTII3. Hence, PTII has somewhat comprehension of the importance of ILO focus.

In response to the question 'How did you identify the focus of ILO-explain with example?', the AUEO3 revealed that

For example, what is a living thing? if the students can answer by memorizing then it is identified as knowledge level LO; the difference between living and non-living things, students have to answer by understanding and this is identified as understand level LO; finally, when they identify living and non-living things through observation then is it identified as application level ILO.

In the statement of AUEO3, the common terms as ILO focus are knowledge, understand and application, which reveals partial concept of AUEO3 about ILO focus. Hence, AUEO3 have somewhat comprehension about the identification of ILO focus.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is no ILO in TB, and TE has given ILOs without focusing learning domains. Therefore, this approach is somewhat addressed in TE, and in TB.

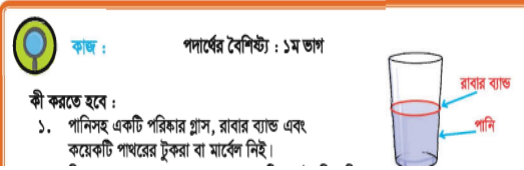
অধ্যায় ৬ পদার্থ আমাদের চারপাশে নানা বস্তু রয়েছে। যেমন- বই, খাতা, চেয়ার, টেবিল, জামা-কাপড়, ধূলিকণা, গাছপালা, পাহাড় ইত্যাদি। সকল বস্তুই পদার্থ দিয়ে তৈরি। ১. পদার্থের বৈশিষ্ট্য পদার্থের বিভিন্ন ধরনের বৈশিষ্ট্য রয়েছে। যেমন- ওজন, আয়তন, আকার, আকৃতি ইত্যাদি। প্রশ্ন : পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী? (১) আয়তন কাজ : পদার্থের বৈশিষ্ট্য : ১ম ভাগ কী করতে হবে : পানিসহ একটি পরিষ্কার গ্লাস, রাবার ব্যন্ড এবং কয়েকটি পাথরের টুকরা বা মাঝে নিই। 	অধ্যায় ৬ পদার্থ অর্জন উপযোগী যোগ্যতা ১৬.১ পদার্থের ওজন আছে ও জায়গা দখল করে - এ ধারণা লাভ করবে। ১৬.২ পরীক্ষার সাহায্যে পদার্থের বৈশিষ্ট্যের প্রমাণ দিতে পারবে। ১৬.৩ বায়ু যে পদার্থ তা পরীক্ষা করে দেখাতে পারবে। শিখনফল ১৬.১.১ পদার্থের যে ওজন আছে তা বর্ণনা করতে পারবে। ১৬.১.২ পদার্থ জায়গা দখল করে তা ব্যাখ্যা করতে পারবে। ১৬.২.১ পদার্থের ওজন আছে তা সহজ পরীক্ষার মাধ্যমে প্রমাণ করতে পারবে। ১৬.২.২ পদার্থ জায়গা দখল করে তার সহজ প্রমাণ ব্যাখ্যা করতে পারবে। ১৬.২.৩ বায়ুর ওজন আছে, বায়ু জায়গা দখল করে ও বায়ু বল প্রয়োগে বাধা প্রদান করে -বায়ু এই বৈশিষ্ট্যগুলো প্রমাণ করতে পারবে। ১৬.৩.১ বায়ু যে পদার্থ তা পরীক্ষার সাহায্যে প্রমাণ করতে পারবে।
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Figure 4.60: Reflection of Key question in TB

Figure 4.61: Reflection of Key question in TE

A summary finding of stakeholders' level of comprehension about the focus of intended learning outcome is presented in next table.

Table 4.81: Summary of findings on stakeholders' comprehension of ILO focus

Stakeholders	Stakeholders' comprehension about the intension of ILOs			Overall comprehension	Chapter, Lesson & no. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Meaning of ILO	Importance of ILO focus	Way of identify ILO focus				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:6 Lesson: 1 ILO: 16.1.1,16.1.2	lessons-1: somewhat practiced	Not addressed	Somewhat addressed
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lessons: 2 ILO: 16.1.1,16.1.2	lessons-2: somewhat practiced	Not addressed	Somewhat addressed
URC	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lessons: 3 ILO: 16.2.3,16.3.1	lessons-3: somewhat practiced	Not addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 4 ILO: 16.2.3,16.3.1	lessons-4: somewhat practiced	Not addressed	Somewhat addressed
					Chapter: 6 Lesson: 5 ILO: 16.2.3,16.3.1			

The findings reveal that the teacher and concerned stakeholders have somewhat comprehension about the focus of ILOs. The teacher somewhat practiced ILO focus in the science classroom. Textbook (TB) did not mention ILOs; and teacher's editions (TE) somewhat addressed the focus of ILOs.

➤ Overall remarks

Teacher has somewhat comprehension about the focus of ILOs, and this was somewhat reflected in lessons practice. Concerned stakeholders also somewhat comprehend about the focus of ILOs, and this may be reflected in teacher's comprehension.

4.14 Stakeholders' Comprehension about the Approach of Primary Science Textbooks (TB) and Teacher's Edition (TE)

4.14.1 Starting lesson with a key question

Teacher's classroom practice

It has been explored from the four observed lessons that, the teacher started two classes with lesson title related song, the two others with prior knowledge exploring question. After that the teacher started teaching learning activities and did not focus on key question. Moreover, teacher 3 conducted more than one lesson in one class. The next table presents the way of starting a lesson by teacher 3.

Table 4.82: Teacher 3's classroom practice of starting lesson with a key question in Grade-4, Chapter-6 'Matter'

ILO	Lesson in TE	Lesson title	Lesson taken by the teacher	Lesson objectives are given in TE for key question	Key question given in TE and TB	Teacher's focus on key question	Way of starting lesson by the teacher
16.1.1 16.1.2	1	Properties of matter: volume	Lesson-1	What are the common properties of matter?	What are the common properties of matter?	The matter has some general characteristics: volume, weight	Prior knowledge exploring the question

Stakeholders' views

To know the stakeholders' views, they were asked about the importance of key question to start a lesson. Among them PTI instructor 3 narrated that,

It is very important I think, the class starts with a problem and will end with the solution to the problem, science class is like that, the class will be according to the problems. For example, how do plants produce food? This is a problem and a main question; today's class will be with the question.

In the statement, PTII 3 mentioned key question as prior knowledge exploring question that reveal PTII3 did not comprehend key question to start a lesson.

In response to the question ‘What are the focuses of key question to start a lesson in textbooks and teacher’s edition?’, among the stakeholders AUEO3 opined that

Science is a question, the answer will not come if I do not question the students, science TB’s are arranged this way, all lessons of TB and TE provided an activity to get the answer, if students response doing the activity then it is confirmed that the LO has been achieved. But our teacher did not understand TE and TB patterns.

The statement reflects AUEO3’s unawareness about TB and TE as AUEO3 did not notice the provided key question in TB and TE that way. Consequently, AUEO3 did not comprehend the approach of key question in curriculum documents.

Stakeholders were asked about classroom practice of key question to start a lesson. The teacher3 had the reply that,

First I ask them questions from previous lesson or from today’s lesson to explore their prior knowledge, then I always write the lesson focusing question on blackboard after announcing the lesson. In my past class the lesson was ‘What is air? properties of air: 2nd part’, I have written-What are common properties of air? on blackboard, so that the students can know what they are going to learn today.

The statement explores that, the teacher3 focuses prior knowledge on exploring question at the start of a lesson for conducting lesson; that reveal T3 did not comprehend the practice of key question in science classroom.

Students’ response in FGD

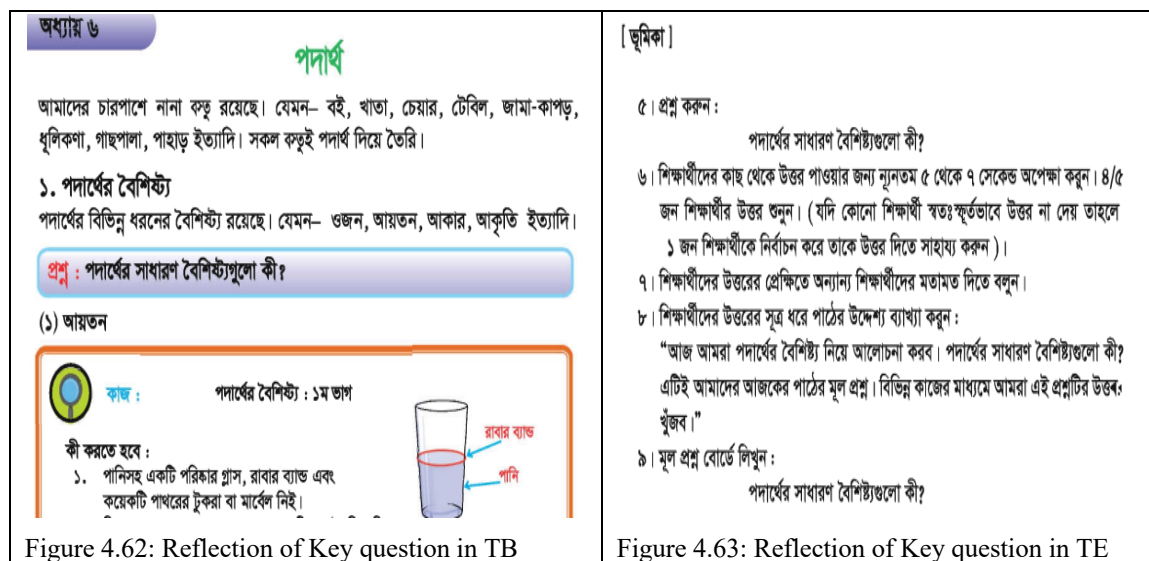
The students of FGD were asked about the way of starting lesson. Their common response was, usually their class starts with reading text from books. One of them stated that

The teacher asks one of us to read the textbook and we all follow; sometimes teacher starts the lesson by singing a song or rhymes or some questions; we answer, if we can’t then sir reply us.

The statement of the student asserts that the teacher did not focus key question to conduct a lesson.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on key question to start a lesson. The key question is highlighted at the starting of teaching-learning activities of each lesson in TB (Figure 4.62) and TE (Figure 4.63). Therefore, this approach is extremely addressed in TB and TE.



[ভূমিকা]

৫। প্রশ্ন করুন:

পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী?

৬। শিক্ষার্থীদের কাছ থেকে উত্তর পাওয়ার জন্য ন্যূনতম ৫ থেকে ৭ সেকেন্ড অপেক্ষা করুন। ৪/৫ জন শিক্ষার্থীর উত্তর শুনুন। (যদি কোনো শিক্ষার্থী স্বতঃস্ফূর্তভাবে উত্তর না দেয় তাহলে ১ জন শিক্ষার্থীকে নির্বাচন করে তাকে উত্তর দিতে সাহায্য করুন।)

৭। শিক্ষার্থীদের উত্তরের প্রেক্ষিতে অন্যান্য শিক্ষার্থীদের মতামত দিতে বলুন।

৮। শিক্ষার্থীদের উত্তরের সূত্র ধরে পাঠের উদ্দেশ্য ব্যাখ্যা করুন:

“আজ আমরা পদার্থের বৈশিষ্ট্য নিয়ে আলোচনা করব। পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী? এটিই আমাদের আজকের পাঠের মূল প্রশ্ন। বিভিন্ন কাজের মাধ্যমে আমরা এই প্রশ্নটির উত্তর খুঁজব।”

৯। মূল প্রশ্ন বোঝে লিখুন:

পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী?

Figure 4.63: Reflection of Key question in TE

The next table summarized the findings of documents analysis, lesson observations, and stakeholders' comprehension to start a lesson.

Table 4.83: Summary of findings about starting lesson with key question

Stakeholders	Stakeholders' comprehension about starting lesson with a key question			Overall comprehension	Chapter & lesson in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of key question	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	not comprehend	not comprehend	not comprehend	not comprehend	Chapter:6 Lesson: 1	lessons-1: didn't practice	Extremely addressed	Extremely addressed
PTI	not comprehend	not comprehend	not comprehend	not comprehend	Chapter: 6 Lessons:2	lessons-2: didn't practice	Extremely addressed	Extremely addressed
URC	not comprehend	not comprehend	not comprehend	not comprehend	Chapter:6 Lessons:3	lessons-3: didn't practice	Extremely addressed	Extremely addressed
AUEO	not comprehend	not comprehend	not comprehend	not comprehend	Chapter: 6 Lesson: 4	lessons-4: didn't practice	Extremely addressed	Extremely addressed
					Chapter: 6 Lesson: 5			

The findings reveal that the teacher and concerned stakeholders did not comprehend starting the lesson with a key question. The teacher did not focus key question in the science classroom. The key question is addressed in textbooks (TB) and teacher's editions (TE).

➤ **Overall remark**

The teacher did not comprehend starting lesson with a key question, and this was reflected in T3's classroom practice. Concerned stakeholders also did not comprehend, and this may be reflected in teacher's comprehension and classroom practices.

4.14.2 Exploring prior knowledge

Teacher's classroom practice

The observed lessons have been explored that, the teacher had explored students' prior knowledge for the first lesson, and explored only review of the lesson for other lessons without exploring prior knowledge. Therefore, that reveals T3 somewhat explored students' prior knowledge. The teacher's classroom practice of prior knowledge exploration of a lesson is shown in the next table.

Table 4.84: Teacher 3's classroom practice of exploring students' prior knowledge in Grade-4, Chapter-Matter

ILO	Lesson in TE	Lesson title	No. of taken classes by the teacher	Prior knowledge exploring Q. given in TB	Prior knowledge exploring Q. given in TE	Question from previous lesson given in TE	Exploring prior knowledge by the teacher
16.1.1 16.2.1	2	What is the weight of matter?	2	Do you think a small piece of paper, a grain of rice has weight?	-	-What is volume? -What are the properties of matter?	-What we learned in the last science class? -what is weight?

Stakeholders' views

Stakeholders were interviewed to know their views about exploring students' prior knowledge. In response to the question 'What is the importance of exploring students' prior knowledge in the relevant topic?', AUEO3 expressed that,

Most of the science lessons are related to the previous lesson and the next lesson, so it is needed to explore prior knowledge of each lesson. The teacher will realize by him/herself how successful yesterday lesson is. And what do students know about today's lesson? Then she/he can decide today's lesson plan. But this trend is very rare for our teachers.

The statement reveals AUEO3's somewhat comprehension of the importance of students' prior knowledge exploration.

Farther, stakeholders were asked about the scope of prior knowledge exploration in lessons in TE and TB. Among the responses, PTI instructor3 said,

It is necessary to explore students' prior knowledge at the start of the lesson. Though both TB and TE provided related information, but our teacher conduct lessons in the usual traditional way by book reading. For example, in lesson "Air takes up space" prior knowledge exploring question is-do you see air? after switching on the fan, ask question-do you feel air? which are provided at TE.

It appears from the statement that, PTII3 was unaware of TB and TE as PTII3 which reveals PTII3 did not comprehend of TB and TE information.

In addition, stakeholders were further asked about the classroom practice of students' prior knowledge exploration. Teacher3 had the reply that,

At first, recall the content of the previous lesson which has a relation with today's lessons, then try to understand how much they know about today's lesson as they do not know about new lesson. These are two types of practice in the classroom. For example, in the 1st lesson on Matter 'Properties of matter: volume' I asked them-Are matter has shape, weight, and volume? To know their idea about matter.

The statement explores T3's somewhat comprehension of classroom practice of prior knowledge exploration.

Students' response in FGD

Students were asked about classroom practice of prior knowledge exploration. One of them had the reply that,

Usually, our class starts with reading textbook. Sometimes, the teacher asked questions on today's lesson or sometimes from the previous lesson.

The statement reveals occasional classroom practice of prior knowledge exploration.

Information provided in TB and TE

Analyzing the observed lessons, conducted by T3 from primary science textbooks it is found that, a very short introduction is placed in the starting of each before teaching learning activity (Figure 4.64). Analyzing the observed lessons in TE it is found that, TE addressed prior knowledge exploring questions for the first lesson of a chapter (Figure 4.65), and addressed questions of review of the previous lesson for the rest lessons (Figure 4.66).

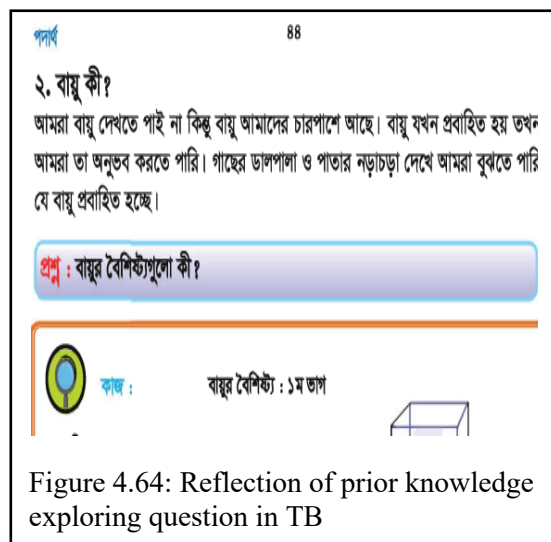


Figure 4.64: Reflection of prior knowledge exploring question in TB

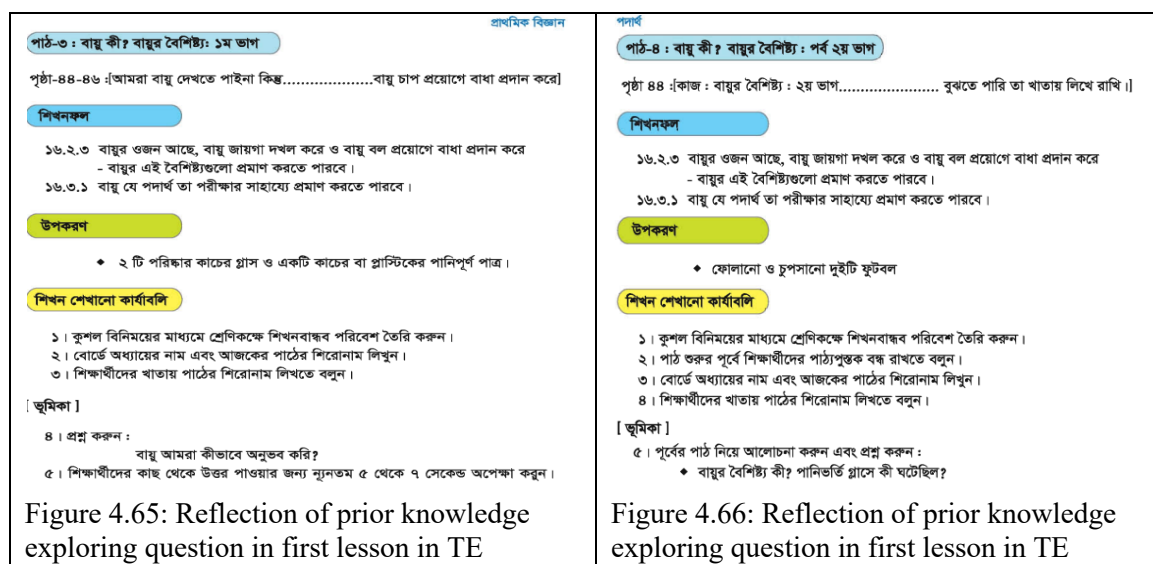


Figure 4.65: Reflection of prior knowledge exploring question in first lesson in TE

Figure 4.66: Reflection of prior knowledge exploring question in first lesson in TE

Although the lessons in a chapter are interrelated and all lessons contain some new additions; therefore, exploring students' prior knowledge is needed besides reviewing the previous lesson in each lesson. Consequently, the Information provided for prior knowledge exploration in TE has been considered as somewhat addressed.

A summary of the findings of documents analysis, lesson observations and stakeholders' comprehension regarding prior knowledge exploration is presented in the next table.

Table 4.85: Summary of findings about the exploration of students' prior knowledge

Stakeholders	Stakeholders' comprehension about exploring students' prior knowledge			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of exploring students' prior knowledge	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:6 Lesson: 1	lessons-1: Somewhat practiced	Somewhat addressed	Somewhat addressed
PTI	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:6 Lessons: 2	lessons-2: Somewhat practiced	Somewhat addressed	Somewhat addressed
URC	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lessons: 3	lessons-3: Somewhat practiced	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 4	lessons-4: Somewhat practiced	Somewhat addressed	Somewhat addressed
					Chapter: 6 Lesson: 5			

The findings of table reveal that teacher 3 and concerned stakeholders have somewhat comprehension about exploring students' prior knowledge. However, teacher sometimes explore students' prior knowledge in the science classroom. The information about exploring students' prior knowledge is somewhat addressed in textbooks (TB) and in teacher's edition (TE).

➤ Overall remark

Teacher has somewhat comprehension about exploring students' prior knowledge, and that was reflected in T3's lessons practice. However, concerned stakeholders' comprehension may be reflected in the teacher's comprehension and classroom practices. The provided information of curriculum documents may also be reflected in T3 and concerned stakeholders' comprehension.

4.14.3 Real-life orientation of science concept

Teacher's classroom practice

In has been observed in lesson observations that, teacher tried to orient the science concepts with some real-life examples and with a very small amount of real material in own way. However, the number of supplied teaching aid was not sufficient for teaching learning activities in all the observed classes of T3, which is indicated as somewhat practice in

Table. Out of four observed lessons of T3, one is shown in the table as a teacher's classroom activity.

Table 4.86: Teacher 3's classroom practice to orient science concept with real life at Grede-4, chapter-Matter

ILO	Lesson in TE	Lesson title	No. of class taken by the teacher	Teaching learning activities and examples are given in TB	Examples are given in TE	Teacher's classroom activity
16.1.1 16.1.2	2	What is the weight of matter?	2	(2) Weight -a balance or a scale for measuring weight	(2) Weight -No example	You can measure weight by balance machine

Stakeholders' views

To know about the necessity of linking real-life situations with science concepts, stakeholders were asked question. URC instructor3 said,

All the science chapters are connected to real life and it is very important, why the environment is changing? What is its impact? What is my responsibility? Students need to be informed about these issues; these all are real life issues.

In the statement, URC instructor 3 explains with examples about real life orientation with science concepts for effective and sustainable learning that express URCI3's understanding; which reveals URCI3's moderate comprehension.

In response to the asked question about the scope of linking real-life situations with science concepts in lessons in TE and TB, Teacher3 said,

There are examples in TE and TB but if 1 or 2 more will be added specifically it is helpful for me to understand the mater or maybe the instruction for us to add something. For example, in lesson 'Matter has weight', I had to give an example like myself that when they are going to buy something from shop apply this knowledge of weight, as there is no example at TE and TB.

The statement explores T3's moderate comprehension of TE information as T3 said not to follow TE that way.

To know stakeholders' views, they were asked to respond about the classroom practice of linking real-life situations with science concepts. Among the stakeholders, AUEO3 alluded

Science is for life, there is nothing to the imagination in science, life-related content is presented in science and it should be; teacher gives example from books and his/her own relating science concept and real life in the classroom so that students can understand easily.

The statement expresses that AUEO3 has moderate comprehension of the classroom practice of linking real-life situations with science concepts.

Students' response in FGD

In response to the asked question about the classroom practice of orienting science concepts with real life, one of them replied that

Our teacher gives example of our known things and sometimes carry sample materials in class. However, the sample materials are too limited that we can't follow, we follow our textbooks.

The statement of the student expresses that Teacher3 focuses on the orientation of science concepts with real life that way.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, the topics and examples of all the chapters are more or less related to our daily life; such as Our environment, materials, food, energy, natural resources, technology, first aid etc. (NCTB, 2020). Both TB and TE provided some real-life examples connecting with science concepts (Figure 4.67 and 4.68).

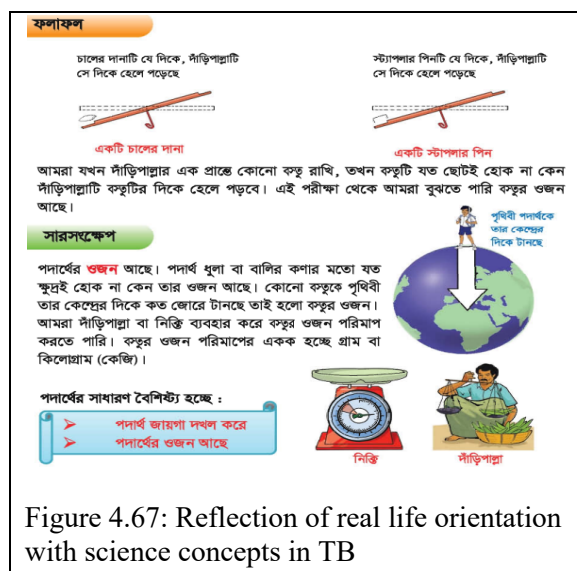


Figure 4.67: Reflection of real life orientation with science concepts in TB

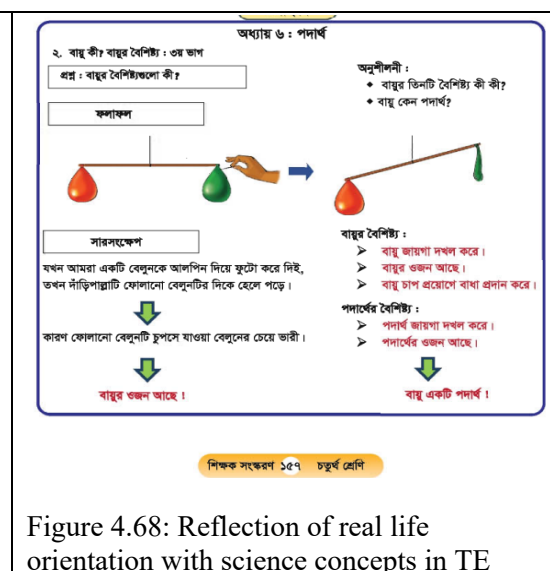


Figure 4.68: Reflection of real life orientation with science concepts in TE

The finding of documents analysis, lesson observations and stakeholders' comprehension regarding orientation of science concepts with real life are summarized in the table.

Table 4.87: Summary of findings about real life orientation of science concept

Stakeholders	Stakeholders' comprehension regarding orientation of science concepts in real life			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of orienting science concept in real life	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:6 Lesson: 1	lessons-1: Moderate practiced	Moderately addressed	Moderately addressed
PTI	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter:6 Lessons: 2	lessons-2: Moderate practiced	Moderately addressed	Moderately addressed
URC	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lessons: 3	lessons-3: Moderate practiced	Moderately addressed	Moderately addressed
AUEO	Somewhat comprehend	Moderately comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson:4	lessons-4: Moderate practiced	Moderately addressed	Moderately addressed
					Chapter: 6 Lesson: 5			

The findings of the table reveal that the teacher and concerned stakeholders have moderate comprehension of the orientation of science concepts to real life. However, teacher moderately orients science concept to real life in the science classroom. The information about orientation of science concept with real life is moderately addressed both in textbooks (TB) and in teacher's edition (TE).

➤ Overall remark

The teacher has moderate comprehension of the orientation of science concept with real life, and that was reflected in T3's classroom practice. However, concerned stakeholders have moderate comprehension, and this may be reflected in T3's comprehension and practice. The information of curriculum documents may also be reflected in T3 and concerned stakeholders' comprehension.

4.14.4 Science process skills

Teacher's classroom practice

It has been explored from the observed lessons that, T3 moderately practiced science process skills in science classes. The teacher's classroom practice focusing science process skills of a lesson is shown in the next table, where T3 somewhat focus on observation skill.

Table 4.88: Teacher 3's classroom practice about science process skills in Grade-4, Chapter-Matter

ILO	Lesson in TE	Lesson title	No. of classes taken by the teacher	science process skills given in TB	science process skills given in TE	Teacher's classroom activity
16.2.3 16.3.1	3	What is air? properties of air: 1 st part	3	-Observation -analysis -Decision making communication	-Observation -analysis -Decision making communication	-Observation communication

Stakeholders' views

Stakeholders were asked 'What are the opportunities for students for achieving science process skills through science learning?'. URC3 alluded,

Process skills are observation, experiment, decision making, etc. these are very important for science learning. All the science concepts provide many scopes to achieve science process skills. For example, "living and non-living things" here observation is a must, students can classify and make decisions for living and non-living through observation, and their learning will be more sustainable.

The statement of URC instructor3 reveals moderate comprehension of science process skills.

In response to the question about the information provided in TE and TB about the opportunities of students for achieving science process skills through science learning, AUEO3 said,

All the science concepts at TB and TE are focused science process skills like- classification, observation, measurement, etc. and students will get the primary concept of life skills and next use it in their real life. For example, in the lesson 'three forms of water', students can easily identify 3 forms of water-solid, liquid, and gas by observation and measurement which information is provided at TE and TB.

In the statement, AUEO3 stated the information provided in TB and TE which reveals AUEO3 has moderate comprehension of the provided information in TB and TE.

Based on the asked question about the classroom practice of achieving science process skills through science learning, teacher 3 said,

I do not know about science process skills deeply, but I completely follow the activities and instructions which are given in TB and TE.

In the statement, T3 alluded to the practice of science process skills in the classroom and that indicates T3's moderate comprehension.

Students' response in FGD

In response to the asked question about the classroom practice of achieving science process skills through science learning, one student of FGD asserted,

Our teacher does the activity first in front of the class, and we follow; after that sometimes we also do the activity following our teacher.

From the statement, it exposes that T3 moderately focuses on science process skills in the classroom.

Information provided in TB and TE

Analyzing the primary science textbooks and teacher's edition it is found that, there are some activities in each lesson focusing science process skills like; demonstration, observation, experiment, investigation, decision making (NCTB, 2020).

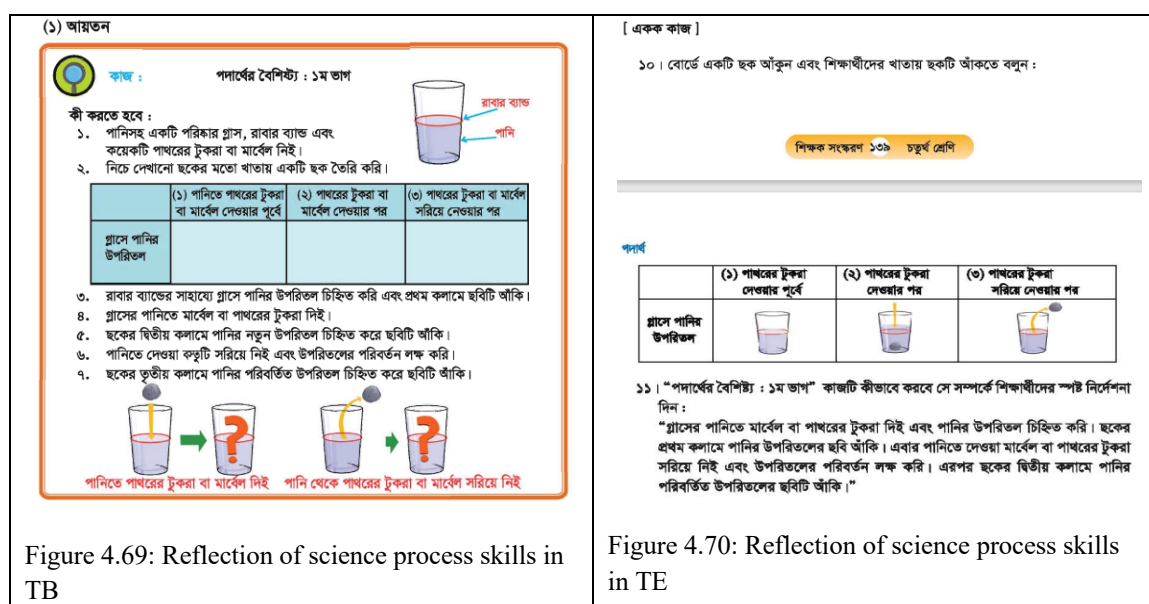


Figure 4.69 reflects science process skill of a lesson in TB; where observation skill is mentioned with activity. Figure 4.70, reflects science process skills in TE where also observation skills is mentioned.

The findings about science process skills from documents analysis (TB & TE), lessons observation and stakeholders' comprehension are summarized in the table.

Table 4.89: Summary of findings about science process skills

Stakeholders	Stakeholders' comprehension regarding orientation of science concepts in real life			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of orienting science concept in real life	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter:6 Lesson: 1	Lessons-1: moderately practiced	somewhat addressed	not addressed
PTI	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter:6 Lessons: 2	Lessons-2: moderately practiced	somewhat addressed	not addressed
URC	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter: 6 Lessons: 3	Lessons-3: moderately practiced	not addressed	not addressed
AUEO	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter: 6 Lesson:4	Lessons-4: moderately practiced	not addressed	not addressed
					Chapter:6 Lesson: 5		not addressed	not addressed

The findings of the table reveal that concerned stakeholders have moderate comprehension about science process skills. T3 moderately focused on science process skills in the science classroom. Science process skills were moderately addressed and sometimes did not address, in the observed analyzed lessons of TB and TE.

➤ Overall remarks

The teacher has moderate comprehension of science process skills, and that was reflected in classroom practice. However, concerned stakeholders also have moderate comprehension, and that may be reflected in teacher's comprehension and classroom practices.

4.14.5 Activity-based class

Teacher's classroom practice

It has been explored from the observed lessons that, T3 did the activities by own self with only one set of materials in front of the class. Students followed the activities and did it again in front of the class within the group. Therefore, T3 has moderately practiced the activity-based class. The table presented T3's classroom activity of activity-based class.

Table 4.90: Teacher 3's classroom practice about activity-based class in Grade-4, Chapter-Matter

ILO	Lesson at TE	Lesson title	lessons taken by the teacher	Given activities in TB	Given activities in TE	Teacher's activity in classroom
16.1.1 16.1.2	1	Properties of matter: volume	Lesson-1	activity showing the volume of matter	Single work: activity of showing the volume of matter Group work: discussion	teacher did the activity and after that student did it

Stakeholders' views

Stakeholders were asked about the importance of activity-based classes for science teaching-learning. In response, AUEO3 said,

Student will learn through activity in group work, everyone has to do in activity-based class, teacher has to create the scope for the students to do in a group. For example, what is air pollution? there is scope to apply activity or process skills.

In the statement, AUEO3 stated activity-based class as group work instead of learners' self-learning with their own ability and skills that reveal AUEO3's somewhat comprehension of activity-based class.

In response to the question about the Information provided of opportunity for activity-based classes in TE and TB, URC instructor3 said,

Activity given at TB is clear to understand and our teacher can easily conduct it through group work if she/he does not follow TE, though TE also provided the information.

In the statement, AUEO3 stated activity-based class as group work; but there mentioned self-activity and then group activity in TB and TE. Therefore, AUEO3's somewhat comprehension of activity-based class.

Stakeholders were asked about the classroom practice of activity-based classes. The Teacher3 stated that

I ask students to do the work, if everyone does not participate at least the activity needs to be done in group. For example, in the past class lesson 'volume of air' I did the given activity and students observed it, in maximum cases, they do not know what is happening so I have to tell them the result of the activity.

In the statement, T3 explained activity-based learning as group work with group discussion. However, this statement reveals T3's somewhat comprehension about activity-based learning.

Students' response in FGD

Students of FGD were asked about the classroom practice of activity-based class. One of them had the reply that,

Usually, we do not get the chance to do any activity in science classes. Sometimes the teacher did it only in front of the class by own self.

The statement explores T3 somewhat practice activity in the science classroom.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that there are activities in each lesson (Figures 4.71 and 4.72). In all the observed lessons, TB addressed activities as single work whereas in TE it is instructed as group work. The Information provided may create confusion to the stakeholders.

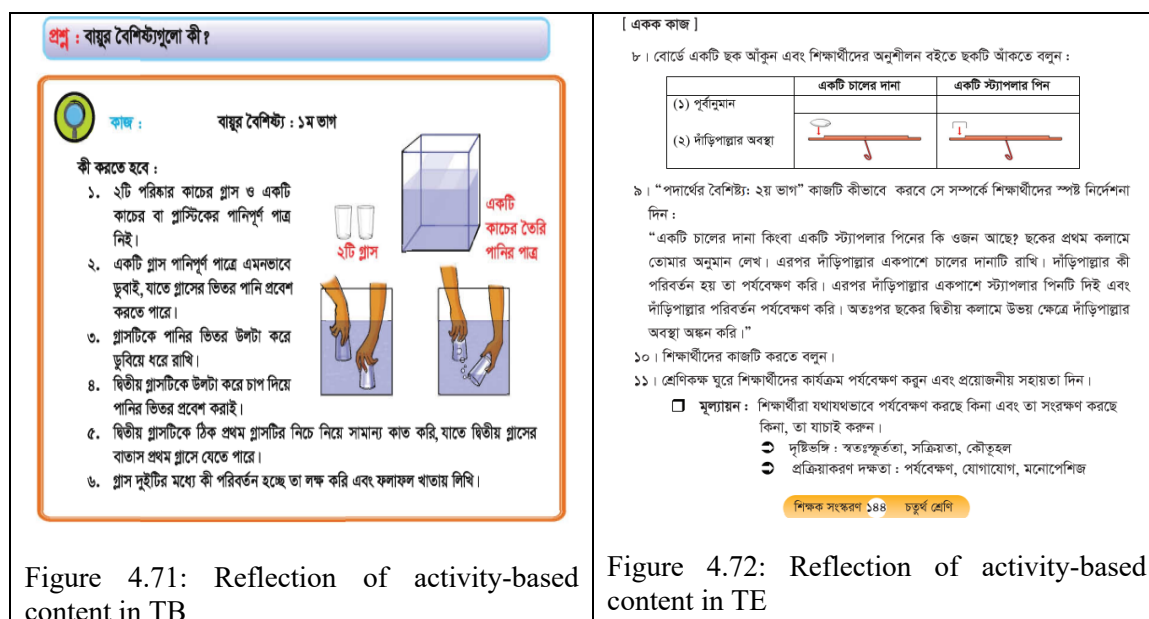


Figure 4.71: Reflection of activity-based content in TB

Figure 4.72: Reflection of activity-based content in TE

A summary of finding of activity-based class from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the table.

Table 4.91: Summary of findings about activity-based class

Stakeholders	Stakeholders' comprehension regarding orientation of science concepts in real life			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of activity based science class	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	somewhat comprehend	somewhat comprehend	somewhat comprehend	somewhat comprehend	Chapter:6 Lesson: 1	lessons-1: Somewhat practiced	Moderately addressed	Moderately addressed
PTI	somewhat comprehend	somewhat comprehend	somewhat comprehend	somewhat comprehend	Chapter:6 Lessons: 2	lessons-2: Somewhat practiced	Moderately addressed	Moderately addressed
URC	somewhat comprehend	somewhat comprehend	somewhat comprehend	somewhat comprehend	Chapter: 6 Lessons: 3	lessons-3: Somewhat practiced	Moderately addressed	Moderately addressed
AUEO	somewhat comprehend	somewhat comprehend	somewhat comprehend	somewhat comprehend	Chapter: 6 Lesson:4	lessons-4: Somewhat practiced	Moderately addressed	Moderately addressed
					Chapter: 6 Lesson: 5		Moderately addressed	Moderately addressed

The findings of the table reveal that concerned stakeholders have moderate comprehension about activity-based class. T3 is somewhat focused on activities in science classroom. Activities are moderately addressed in the observed lessons of TB and TE.

➤ Overall remarks

The teacher has moderate comprehension of activity-based classes and that was reflected in T3's classroom practice. However, concerned stakeholders have moderate comprehension, and that may be reflected in teacher's comprehension and classroom practices. Furthermore, curriculum documents are also moderately addressed and this may also be reflected in T3 and concerned stakeholders' comprehension.

4.14.6 Collaborative approach

Teacher's classroom practice

Out of four lessons, the teacher seated the students into groups for group discussion. So, students get the chance to share their ideas with others. Therefore, the teacher somewhat focused on collaborative approach in the science classroom. T3's classroom activity a lesson is shown in the table next.

Table 4.92: Teacher 3's classroom practice of collaborative approach in Grade-4, Chapter-Matter

ILO	Lesson in TE	Lesson title	Class taken by the teacher	Collaborative approach given in TB	Collaborative approach given in TE	Teacher's activity in classroom
16.1.1 16.1.2	1	Properties of matter: volume	1	Group discussion with given questions	Group discussion with given questions	Write given Q-A with group discussion

Stakeholders' views

Stakeholders were asked for their opinion about the collaborative approach in science teaching-learning. Teacher3 said,

Collaborative learning is learning where students can learn with a group discussion; one understands a little more, the other understands a little less, discussion in groups fill their knowledge gaps.

In the statement T3 explained the collaborative approach as group discussion which reveals T3's moderate comprehension of the collaborative approach.

Stakeholders were asked about the opportunity of the collaborative approach mentioned in TE and TB. Among the stakeholders, AUEO3 said,

There is scope to learn by the cooperation of students in science learning and both TB and TE provide group work for that. It is said to one student of the group to help other members within group so that the weak students are able to understand.

From the statement it states that AUEO3 has moderate comprehension of the information of TB and TE.

Stakeholders were asked about the practice of the collaborative approach in the classroom. URC instructor 3 said,

Students try to participate and understand the matter through group work, but in a large class it is not possible to maintain group work and students learning does not come up through group work, only 3-4 will be active but the rest of them sit in a group of 10-12 students, it is tough for the teacher to ensure all students learning within 40 minutes in a large classroom.

However, the comprehension of URCI3 was somewhat about classroom practice of collaborative approach as URCI3 expressed excuses for not practicing in the classroom.

Students' response in FGD

Students of FGD were asked about the classroom practice of the collaborative approach. One of them replied,

Sometimes they seated into groups and fill up the given chart and table following textbooks and group discussion; the maximum time they do it following the teacher's instruction on the board.

In the statement of the student, it reveals that T3 sometimes practices a collaborative approach in the science classroom.

Information provided in TB and TE

Analyzing the primary science textbooks and teacher's edition of observed lessons, it is found that there is mention of discussion with classmates in TB (Figure 4.73) and instructed group activities with group discussion in TE (Figure 4.74).

কাজ :

পদার্থের বৈশিষ্ট্য : ২য় ভাগ

কী করতে হবে :

১. খঁট দিয়ে একটি দাঁড়িপাল্লা তৈরি করি এবং একটি চালের দানা ও একটি স্ট্যাপলার পিন নিই।

একটি চালের দানা

একটি স্ট্যাপলার পিন

একটি দাঁড়িপাল্লা

২. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

	একটি চালের দানা	একটি স্ট্যাপলার পিন
(১) অনুমান :		
(২) দাঁড়িপাল্লার অবস্থা		

৩. এক হাতের উপর একটি চালের দানা রাখি। এরপর একটি স্ট্যাপলার পিন রাখি। কোনো গুঁড়ন অনুভব করছি কি? অনুমানটি ছকের (১) সারিতে লিখি।

৪. দাঁড়িপাল্লার একপাশে চালের দানাটি রাখি।

৫. দাঁড়িপাল্লার কী পরিবর্তন হয় তা পর্যবেক্ষণ করি। দাঁড়িপাল্লার অবস্থাটি ছকের (২) সারির ১ম কলামে অঙ্কন করি।

৬. এরপর দাঁড়িপাল্লার একপাশে স্ট্যাপলার পিনটি নিই।

৭. দাঁড়িপাল্লার অবস্থার কী পরিবর্তন হয় তা পর্যবেক্ষণ করি। দাঁড়িপাল্লার অবস্থাটি ছকের (২) সারির ২য় কলামে অঙ্কন করি।

৮. কাজটি নিয়ে সহপাঠীর সাথে আলোচনা করি।

[দলীয় কাজ]

১৫। এবার শিক্ষার্থীদের করেকটি দলে ভাগ করুন।

১৬। শিক্ষার্থীদের উদ্দেশ্যে নিচের প্রশ্নগুলো করুন :

- ♦ পানিতে কোনো বস্তু দেওয়া হলে পানির উপরিতলের কী পরিবর্তন হয়?
- ♦ বস্তুটি সরিয়ে নেওয়া হলে পানির উপরিতলের কী পরিবর্তন হয়?
- ♦ ফ্লাকল থেকে পদার্থের কোন বৈশিষ্ট্য আমরা অনুমান করতে পারি?

১৭। শিক্ষার্থীদের দলে আলোচনা করতে বলুন এবং সারসংক্ষেপ করতে বলুন।

১৮। প্রেক্ষিক ঘুরে শিক্ষার্থীদের কাজ পর্যবেক্ষণ করুন এবং গ্রুপে গ্রুপে দলীয় আলোচনায় সহায়তা দিন।

শিক্ষক সংস্করণ ১৪০ চতুর্থ প্রেপি

Figure 4.73: Reflection of collaborative approach in TB

Figure 4.74: Reflection of collaborative approach in TE

Figure 4.73: Reflection of collaborative approach in TB

Figure 4.74: Reflection of collaborative approach in TE

The findings of the collaborative approach from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table.

Table 4.93: Summary of findings about the collaborative approach

Stakeholders	Stakeholders' comprehension collaborative approach			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of collaborative approach	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Moderately comprehend	Moderately comprehend	somewhat comprehend	Moderately comprehend	Chapter:6 Lesson: 1	lessons-1: Somewhat practiced	Moderately addressed	Moderately addressed

Stakeholders	Stakeholders' comprehension collaborative approach			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of collaborative approach	Given information in TE & TB	Way of practice in classroom				In TB	In TE
PTI	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter:6 Lessons: 2	lessons-2: Somewhat practiced	Moderately addressed	Moderately addressed
URC	Moderately comprehend	Moderately comprehend	somewhat comprehend	Moderately comprehend	Chapter: 6 Lessons: 3	lessons-3: Somewhat practiced	Moderately addressed	Moderately addressed
AUEO	Moderately comprehend	Moderately comprehend	somewhat comprehend	Moderately comprehend	Chapter: 6 Lesson:4	lessons-4: Somewhat practiced	Moderately addressed	Moderately addressed
					Chapter: 6 Lesson: 5		Moderately addressed	Moderately addressed

The findings of the table reveal that T3 and concerned stakeholders have moderate comprehension of the collaborative approach. T3 moderately focused collaborative approach in the science classroom. The information on the collaborative approach has been moderately addressed in TB and in TE.

➤ Overall remarks

Teacher3 has somewhat comprehension about the collaborative approach, and this was reflected in T3's classroom practice. However, concerned stakeholders also have moderate comprehension; and this may be reflected in the teacher's comprehension and classroom practices. The information provided for the collaborative approach in curriculum documents may also be reflected in T3 and concerned stakeholders' comprehension.

4.14.7 Illustrations (Pictures and Photographs)

Teacher's classroom practice

There are content related photographs and illustrations for activities and examples in TB. The teacher somewhat focused on any illustrations or photographs provided in TB and TE that way. The teacher's one lesson of classroom practice is presented in the table next.

Table 4.94: Teacher 3's classroom practice regarding illustrations in Grade-4, Chapter- Matter

ILO	Lesson in TE	Lesson title	No. of classes taken by the teacher	Given illustrations in TB	Given illustrations in TE	Activities done by the teacher
16.2.3 16.3.1	3	What is air? properties of air: 1 st part	3	-picture of the given activity	-picture of the given activity	Did the activity

Stakeholders' views

Stakeholders were asked about the importance of illustrations to achieve content knowledge. AUEO3 said,

The illustrations are relevant to the content and very important, it helps the teacher and helps the students to understand the content even though they are semi-real. For example, in the lesson "Matter has volume" the given activity is shown with an illustration both at TB and TE, so it is easy activity.

In the statement, AUEO3 stated the importance of illustrations and that reveals AUEU3's moderate comprehension of illustrations.

Stakeholders were asked about the consistency of the text and Illustrations mentioned in TE and TB. T3 alluded,

Almost all the contents cover illustrations at TB and it has consistency with the text. For example, in chapter 'Matter' all the set activity has illustration and this is consistency with the text and helps me a lot and the students also to understand what to do in the activity.

The statement reveals T3's moderate comprehension of illustrations.

Participants were asked about the practice of illustration and diagrams in the classroom. URC instructor3 said,

All illustrations are related to the contents, the teacher uses them directly or makes them in an enlarged form as a teaching aid in the classroom, they use it at the early of the class, this makes the lesson easy and students can understand what will happen or learn from today's lesson.

The statement reveals URC3's moderate comprehension of classroom practice of illustrations.

Students' response in FGD

Students of FGD were asked about the classroom practice of illustrations and diagrams. One of them replied,

Our classes conduct with reading text from textbooks; then we notice the picture from textbooks that teacher instruct us to follow. Our teacher does not focus it separately.

In the statement of the student, it reveals that the teacher somewhat focuses on illustration and photographs in the science classroom.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, there are content related photographs and illustrations for activities and examples in TB. Therefore, science concept related photographs are available, which helps students to understand science concepts linked to real life. However, in some cases illustrations are provided rather than photographs. it might be more relevant to the content if photographs are provided.

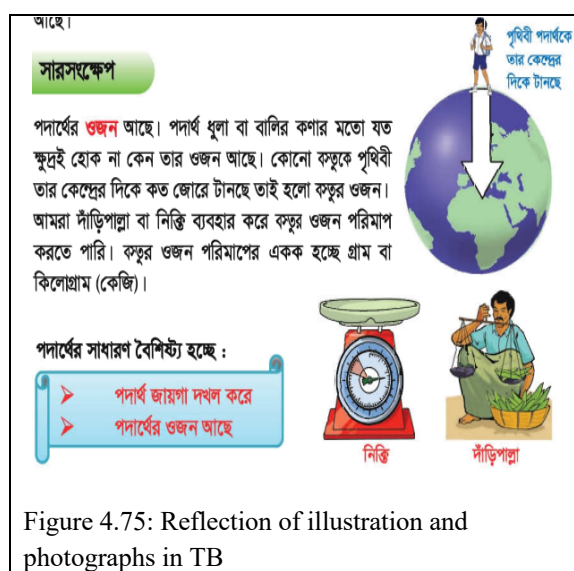


Figure 4.75: Reflection of illustration and photographs in TB

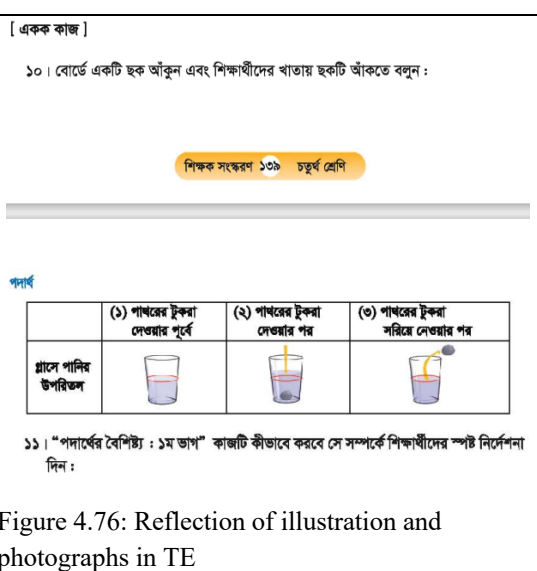


Figure 4.76: Reflection of illustration and photographs in TE

The findings of provided illustrations from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table.

Table 4.95: Summary of findings about illustrations

Stakeholders	Stakeholders' comprehension about illustrations			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of illustrations	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter:6 Lesson: 1	lessons-1: Did not practice	Moderately addressed	Somewhat addressed
PTI	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter:6 Lessons: 2	lessons-2: Did not practice	Moderately addressed	Not addressed

Stakeholders	Stakeholders' comprehension about illustrations			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of illustrations	Given information in TE & TB	Way of practice in classroom				In TB	In TE
URC	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter: 6 Lessons: 3	lessons-3: Somewhat practiced	Moderately addressed	Somewhat addressed
AUEO	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Chapter: 6 Lesson:4	lessons-4: Somewhat practiced	Moderately addressed	Not addressed
					Chapter: 6 Lesson: 5		Moderately addressed	Not addressed

The findings of the table reveal that T3 and concerned stakeholders have moderate comprehension of the collaborative approach. T3 somewhat focused collaborative approach in the science classroom. Illustrations have been moderately addressed in TB, and mostly did not address in the observed lessons of TE.

➤ Overall remarks

Teacher3 has moderate comprehension of the collaborative approach, and its reflection was not found in T3's classroom practice. However, concerned stakeholders also have moderate comprehension; and this may be reflected in the teacher's comprehension. The provided illustrations in curriculum documents may also be reflected in T3 and concerned stakeholders' comprehension.

4.14.8 Scope of scientific inquiry

Teacher's classroom practice

Four lessons of T3 have been observed. Findings of one observed lesson are presented in the next table, where it is explored that, T3 did the activity by own self with a group of students without following inquiry steps sequentially.

Table 4.96: Teacher 3's classroom practice regarding illustrations in Grade-4, Chapter-6, 'Matter'

ILO	Lesson in TE	Lesson title	No. of lesson taken by the teacher	Information is given in TB	Information is given in TE	Teacher's classroom practice
16.2.3 16.3.1	3	What is air? properties of air: 1 st part	3	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify the explanation	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify the explanation	* Did the given activity by own self with a group of students

Stakeholders' views

Stakeholders were asked for their opinion about inquiry-based teaching. PTI instructor³ said,

Inquiry that contains investigative work like discovery, teacher directed investigation, student planned investigation; for example, in lesson 'Environment'-teacher instructs students to look outside from classroom-what is in our environment? this is only observation, there are many scopes for an inquiry like observation, classification, etc. if they go outside then find it.

The explanation of PTII³ reveals that PTII³ did not comprehend inquiry-based teaching.

Stakeholders were asked about the opportunity for inquiry-based teaching mentioned in TE and TB. Teacher³ said,

I do not understand inquiry; I do not think that way, but try to follow TB and TE provided activities for science classes.

In the statement, T³ mentioned the provided activities for inquiry-based classes in TB that reveals T³ did not comprehend inquiry-based teaching.

Participants were asked about the practice of inquiry in science classroom. AUEO³ said,

Inquiry-based learning is the learning where students learn unknown with the help of known things. For example, the teacher wants to know students' understanding after the lecture; so told them to go outside the class and classify the plants around them; students classify plants according to the class lecture-this is inquiry.

In the explanation of AUEO³ it reveals AUEO³ did not comprehend inquiry-based teaching practice in the science classroom.

Students' response in FGD

Students' of FGD were asked about their way of learning through inquiry. One of them stated that,

We could not get the chance to do any activity in the science classroom. Maximum time our class conducts through text reading from the textbook and teacher asks us question or instruct us to write the Q-A.

In the statement of the student, it asserts that the focus of T3's classroom activity is not inquiry.

Provided information in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on inquiry-based teaching.

১. পদার্থের বৈশিষ্ট্য
পদার্থের বিভিন্ন ধরনের বৈশিষ্ট্য রয়েছে। যেমন— গুণন, আয়তন, আকার, আকৃতি ইত্যাদি।

প্রশ্ন : পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী?

(১) আয়তন

কাজ : পদার্থের বৈশিষ্ট্য : ১ম ভাগ

কী করতে হবে :

১. পানিসহ একটি পরিষ্কার গ্রাস, রাবার ব্যান্ড এবং কয়েকটি পাথরের টুকরা বা মার্বেল নিই।
২. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

	(১) পানিতে পাথরের টুকরা বা মার্বেল দেওয়ার পূর্বে	(২) পাথরের টুকরা বা মার্বেল দেওয়ার পর	(৩) পাথরের টুকরা বা মার্বেল সরিয়ে দেওয়ার পর
গ্রাসে পানির উপরিতল			

৩. রাবার ব্যান্ডের সাহায্যে গ্রাসে পানির উপরিতল চিহ্নিত করি এবং প্রথম কলামে ছবিটি আঁকি।
৪. গ্রাসের পানিতে মার্বেল বা পাথরের টুকরা দিই।
৫. ছকের দ্বিতীয় কলামে পানির নতুন উপরিতল চিহ্নিত করে ছবিটি আঁকি।
৬. পানিতে দেওয়া কতটি সরিয়ে নিই এবং উপরিতলের পরিবর্তন লক্ষ্য করি।
৭. ছকের তৃতীয় কলামে পানির পরিবর্তিত উপরিতল চিহ্নিত করে ছবিটি আঁকি।

পানিতে পাথরের টুকরা বা মার্বেল দিই পানি থেকে পাথরের টুকরা বা মার্বেল সরিয়ে নিই

৪১ প্রাথমিক বিজ্ঞান

আলোচনা

◆ পর্যবেক্ষণ থেকে নিচের বিষয়গুলো নিয়ে চিন্তা করি।

১. পানিতে কোনো কত দেওয়া হলে পানির উপরিতলের কী পরিবর্তন হয়?
২. কতটি সরিয়ে নেওয়া হলে পানির উপরিতলের কী পরিবর্তন হয়?
৩. ফলাফল থেকে পদার্থের কোন বৈশিষ্ট্য আমরা অনুমান করতে পারি?

ফলাফল

পাথরের টুকরা দেওয়ার পূর্বে পাথরের টুকরা দেওয়ার পর পাথরের টুকরা সরিয়ে নেওয়ার পর

যখন গ্রাসের পানিতে পাথরের টুকরা বা মার্বেল দেওয়া হয় তখন পানির উপরিতল রাবার ব্যান্ড চিহ্নিত স্থানের উপরে উঠে। আবার পাথরের টুকরা বা মার্বেল সরিয়ে নিলে পানির উপরিতল রাবার ব্যান্ড চিহ্নিত স্থানে নেমে আসে। এই পরীক্ষাটি থেকে আমরা এই সিদ্ধান্তে আসতে পারি যে, পাথরের টুকরা বা মার্বেল পানির মধ্যে নিজের জন্য জায়গা দখল করেছে।

সারসংক্ষেপ

Figure 4.77: Reflection if inquiry-based learning in TB

পদার্থ
[একক কাজ]

- ৯। “বায়ুর বৈশিষ্ট্য : ১ম ভাগ” কাজটি কীভাবে করবে সে সম্পর্কে স্পষ্ট নির্দেশনা দিন : “গ্রাস দুইটিকে পানিতে ডুবাই। একটি গ্রাস পানিভর্তি করে তা উল্টা করে ডুবিয়ে রাখি। অন্য গ্রাসটি উল্টা করে চাপ দিয়ে পানিভর্তি গ্রাসটির নিচে নিয়ে সামান্য কাত করি। এবার গ্রাস দুইটিতে কী ঘটে তা পর্যবেক্ষণ কর এবং ফলাফল খাতায় লেখ।”
- ১০। শিক্ষার্থীদের কাজটি করতে বলুন।
- ১১। প্রেক্ষিক যুরে শিক্ষার্থীদের কার্যক্রম পর্যবেক্ষণ করুন এবং প্রয়োজনীয় সহায়তা দিন।
 - ❑ **মূল্যায়ন :** শিক্ষার্থীরা যথাযথভাবে পর্যবেক্ষণ করেছে কিনা এবং তাদের পর্যবেক্ষণ লিপিবদ্ধ করেছে কিনা, তা যাচাই করুন।
 - ➔ দৃষ্টিভঙ্গি : স্বতঃস্ফূর্ততা, সক্রিয়তা, কৌতূহল
 - ➔ প্রক্রিয়াকরণ দক্ষতা : পর্যবেক্ষণ, পূর্বানুমান, সিদ্ধান্ত গ্রহণ

[দলীয় কাজ]

- ১২। এবার শিক্ষার্থীদের কয়েকটি দলে ভাগ করুন।
- ১৩। শিক্ষার্থীদের তাদের পরীক্ষার ফলাফল নিয়ে দলে আলোচনা করতে বলুন এবং আলোচনার সারসংক্ষেপ খাতায় লিখতে বলুন।
- ১৪। প্রেক্ষিক যুরে শিক্ষার্থীদের কাজ পর্যবেক্ষণ করুন প্রয়োজনে দলীয় আলোচনায় শিক্ষার্থীদের সহায়তা দিন।
 - ❑ **মূল্যায়ন :** শিক্ষার্থীরা দলীয় কাজে সক্রিয়ভাবে অংশগ্রহণ করেছে কিনা এবং একে অন্যকে সহযোগিতা করেছে কিনা যাচাই করুন।
 - ➔ দৃষ্টিভঙ্গি : মুক্ত মানসিকতা, যাচাই প্রবণতা
 - ➔ প্রক্রিয়াকরণ দক্ষতা : পর্যবেক্ষণ, বিশ্লেষণ, সিদ্ধান্ত গ্রহণ, যোগাযোগ

[সারসংক্ষেপ]

- ১৫। প্রত্যেক দল থেকে ১ জনকে দলীয় আলোচনার সারসংক্ষেপ উপস্থাপন করতে বলুন।
- ১৬। বোর্ডে তাদের উপস্থাপিত মতামত লিখুন।
- ১৭। প্রশ্ন করুন :
 - ➔ গ্রাস দুইটির মধ্যে কী ঘটেছিল? কেন ঘটেছিল?
 - ➔ খটনাটির ফলাফল থেকে বায়ুর কোন বৈশিষ্ট্য লক্ষ করা যায়?
- ১৮। শিক্ষার্থীদের কাছ থেকে উত্তর পাওয়ার জন্য মূল্যতম ৫ থেকে ৭ সেকেন্ড অপেক্ষা করুন। ৪/৫ জন শিক্ষার্থীর উত্তর শুনুন। (যদি কোনো শিক্ষার্থী স্বতঃস্ফূর্তভাবে উত্তর না দেয় তাহলে ১ জন শিক্ষার্থীকে নির্বাচন করে তাকে উত্তর দিতে সাহায্য করুন।)
- ১৯। শিক্ষার্থীদের উত্তরের প্রেক্ষিতে অন্য শিক্ষার্থীদের মতামত দিতে বলুন।

শিক্ষক সংক্ষেপ ১৪৮ চতুর্থ প্রেণি

প্রাথমিক বিজ্ঞান

- ২০। শিক্ষার্থীদের পাঠ্যবই খুলতে বলুন এবং নিচের চিত্রের সাহায্যে বোর্ডে বায়ুর বৈশিষ্ট্য ও আয়তন সজ্জাক্রম আঁকের পাঠসংগৃহীত সারসংক্ষেপ পড়তে বলুন।

- ২১। পাঠের মূল প্রশ্নটি করুন, তাদের উত্তর শুনুন এবং যাচাই করুন।
- ২২। পরবর্তী পাঠে করণীয় সম্পর্কে নির্দেশনা দিন এবং ধন্যবাদ জারিয়ে পাঠ সমাপ্ত করুন।

Figure 4.78: Reflection if inquiry-based learning in TE

Figures 4.77 and 4.78 presents the reflection of inquiry in TB and TE where a process of inquiry-based teaching: engaging with a scientific question, collecting data, formulating explanation, evaluating an explanation and justifying an explanation are somewhat addressed in TB and moderately addressed in TE.

The finding of documents analysis, lesson observations and stakeholders' comprehension regarding inquiry-based teaching are summarized in the table.

Table 4.97: Summary of findings about inquiry-based teaching

Stakeholders	Stakeholders' comprehension about inquiry-based teaching			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of inquiry-based teaching	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:6 Lesson: 1	lessons-1: Did not practice	Somewhat addressed	Somewhat addressed
PTI	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:6 Lessons: 2	lessons-2: Did not practice	Somewhat addressed	Somewhat addressed
URC	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lessons: 3	lessons-3: Did not practice	Somewhat addressed	Somewhat addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson:4	lessons-4: Did not practice	Somewhat addressed	Somewhat addressed
					Chapter: 6 Lesson: 5		Somewhat addressed	Somewhat addressed

The findings of the table reveal that T3 and concerned stakeholders did not comprehend inquiry-based teaching. However, T3 did not practice inquiry in the science classroom. The inquiry-based teaching approach is somewhat addressed in TB and TE.

➤ Overall remarks

Teacher 3 comprehension was reflected in classroom practice. Concerned stakeholders' comprehension may also be reflected in T3's comprehension and classroom practices. Though the provided information on inquiry-based teaching in curriculum documents is moderate; it was not reflected in T3 and concerned stakeholders' comprehension

4.14.9 Lesson summary

Teacher's classroom practice

The teacher randomly instructed a few students to read the text after teaching-learning activities in all the observed classes; that was mentioned as somewhat practice in the next

table. One of the teacher's classroom practices is presented in the table next.

Table 4.98: Teacher 3's classroom practice of lesson summary in Grade-4, Chapter-6, 'Matter'

ILO	Lesson in TE	Lesson title	No. of class taken by the teacher	Summary given in TB	Summary was given in TE	Activities done by the teacher
16.1.1 16.1.2	1	Properties of matter: volume	1	text about volume of matter, measure of solid and liquid matter	-fill up the table on board with receiving answer from group -explain it -instruct to read the summary from book -ask key Q., receive and justify their answer -instruct about the next lesson	-instructed students to fill up the table on notebook with group discussion -asked them the main question -instructed to read the summary from book

Stakeholders' views

Stakeholders were asked for their opinion about the importance of lesson summary. PTI instructor3 said,

Usually, the summary is given as a solution and description after an activity placed at both TB and TE; the teacher who does not understand the activity, the summary is suitable for him to understand the activity and content; the teacher can summarize anything when she/he understands the content perfectly.

The statement reveals PTII3's somewhat comprehension about lesson summary.

Moreover, stakeholders were asked for their opinion about information provided in TE and TB. URC instructor3,

Lesson summary is the recall of the whole lesson what they learn today, it is at the end of the lesson, in this context teacher can ask questions and review through assessment in classroom.

The statement reveals URCI3's somewhat comprehension of provided information in the lesson summary.

Stakeholders were asked about the practice of lesson summary in classroom. AUEO3 replied,

Our primary level students could not read properly, so the main target of our teacher is to read out the text by the students and they do it again and again.

In the statement, AUEO3 emphasizes the practice of lesson summary is for students' memorization through reading the text again and again rather than their understanding, which express the somewhat comprehension of AUEO3.

Students' response in FGD

Students of FGD were asked about the classroom practice of lesson summary. One of them replied,

Teacher instructs us to read this text again and again to memorize lessons, we do it in groups or individually, then the teacher asks us questions.

In the statement of the student, it reveals that the teacher wants the students to memorize by reading the text over and over again.

Provided information in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, summary is placed as content text in TB, whereas TE highlighted it as the end part of LA which may create confusion of the stakeholders.

সারসংক্ষেপ

পদার্থ জায়গা দখল করে। যেমন- একটি বই টেবিলের উপরের জায়গা দখল করে। যখন পদার্থ কোনো জায়গা দখল করে, ওই জায়গাটি একই সাথে অন্য কোনো পদার্থ দখল করতে পারে না। কোনো পদার্থ যে পরিমাণ জায়গা দখল করে তাকে তার আয়তন বলে। আয়তন পদার্থের একটি বৈশিষ্ট্য।

কঠিন পদার্থের আয়তন ঘন সেন্টিমিটার (ঘন সেমি) বা মিটার এককে পরিমাপ করা হয়। তরল পদার্থের আয়তন পরিমাপের একক হলো মিলিলিটার বা লিটার।



পদার্থ টেবিলে জায়গা দখল করেছে

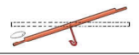
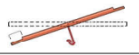


কঠিন পদার্থ তরল পদার্থ

Figure 4.79: Reflection of summary in TB

[সারসংক্ষেপ]

১৫। প্রত্যেক দল থেকে ১ জনকে দলীয় আলোচনার সারসংক্ষেপ উপস্থাপন করতে বলুন।
১৬। বোর্ডে তাদের মতামতের সারসংক্ষেপ করুন।

	একটি চালের দানা	একটি স্ট্যাপলার পিন
(১) পূর্বানুমান		
(২) দাঁড়িপাল্লার অবস্থা		

১৭। নিম্নলিখিত প্রশ্নগুলো করুন:

- দাঁড়িপাল্লার একপাশে চালের দানা/ স্ট্যাপলার পিন রাখায় কী ঘটেছিল?
- কেন তা ঘটেছিল বলে ভূমি মনে কর?
- এই ঘটনা থেকে ভূমি কি কোনো সিদ্ধান্তে আসতে পার?

১৮। শিক্ষার্থীদের কাছ থেকে উত্তর পাওয়ার জন্য ন্যূনতম ৫ থেকে ৭ সেকেন্ড অপেক্ষা করুন। ৪/৫ জন শিক্ষার্থীর উত্তর শুনুন। (যদি কোনো শিক্ষার্থী স্বতঃস্ফূর্তভাবে উত্তর না দেয় তাহলে একজন শিক্ষার্থীকে নির্বাচন করে তাকে উত্তর দিতে সাহায্য করুন)।

১৯। শিক্ষার্থীদের উত্তরের প্রেক্ষিতে অন্য শিক্ষার্থীদের মতামত দিতে বলুন।

২০। পদার্থের গুণনের ধারণা ব্যাখ্যা করুন।

২১। শিক্ষার্থীদের পাঠ্যবই খুলতে বলুন এবং আজকের পাঠসংশ্লিষ্ট সারসংক্ষেপ পড়তে বলুন।

শিক্ষক সংস্করণ ১৪৫ চতুর্থ শ্রেণি

Figure 4.80: Reflection of summary in TE

The findings of lesson summary from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table.

Table 4.99: Summary of findings about lesson summary

Stakeholders	Stakeholders' comprehension about lesson summary			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of lesson summary	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat addressed	Somewhat addressed	Somewhat addressed	Somewhat addressed	Chapter:6 Lesson: 1	lessons-1: Did not practice	Somewhat addressed	Somewhat addressed
PTI	Somewhat addressed	Somewhat addressed	Somewhat addressed	Somewhat addressed	Chapter:6 Lessons: 2	lessons-2: Did not practice	Somewhat addressed	Somewhat addressed
URC	Somewhat addressed	Somewhat addressed	Somewhat addressed	Somewhat addressed	Chapter: 6 Lessons: 3	lessons-3: Did not practice	Somewhat addressed	Somewhat addressed
AUEO	Somewhat addressed	Somewhat addressed	Somewhat addressed	Somewhat addressed	Chapter: 6 Lesson:4	lessons-4: Did not practice	Somewhat addressed	Somewhat addressed
					Chapter: 6 Lesson: 5		Somewhat addressed	Somewhat addressed

The findings of the table reveal that, T3 and concerned stakeholders have somewhat comprehension of summary. T3 was somewhat focused summary in the science classroom. The information of summary somewhat addressed in TB and in TE

➤ Overall remarks

Teacher3 has somewhat comprehension about summary, and this was reflected in T3's classroom practice. Concerned stakeholders also have somewhat comprehension, and this may be reflected in the teacher's comprehension and classroom practices. The provided information of summary in curriculum documents may also be reflected in T3 and concerned stakeholders' comprehension.

➤ Overall remarks about the comprehension of the approaches of primary science textbooks and teacher's edition to facilitate inquiry-based teaching

The teacher has somewhat comprehension of most of the approaches of TB and TE. The teacher's somewhat comprehension was somewhat reflected in most of the approaches of TB and TE during classroom practices. Students also revealed that the teacher somewhat focuses most of the approaches of TB and TE in the science classroom. Concerned stakeholders' somewhat comprehension of most of the approaches of TB and TE; may be reflected in teacher's comprehension and classroom practices. Curriculum documents (TB & TE) moderately addressed most of the identified approaches, but it may be somewhat reflected in T3 and concerned stakeholders' comprehension.

4.15 Learning Opportunities in Inquiry-based Teaching

4.15.1 Step-1. Students are engaged by scientifically oriented questions

Teacher's classroom practice

It has been explored from the observed lessons that, after prior knowledge exploration or review of the previous lesson, the teacher started teaching learning activities. However, the teacher did not engage the students in scientifically oriented questions. The next table shows the way of engaging students with a lesson by the teacher.

Table 4.100: Teacher 3's classroom practice about engaging students with scientifically oriented question

Grade & Chapter	ILO	Lesson title	Lessons in TE	Lesson taken by the teacher	Provided information in TB and TE (Key Q.)	Teachers' activity in classroom
Grade-4, Chapter-6: 'Matter'	16.2.3 16.3.1	What is air? properties of air: 2 nd part	4	Lesson-4	What is another common property of air?	Mentioned after exploration of prior knowledge and lesson declaration
	16.2.3 16.3.1		5		What are common properties of air?	

Stakeholders' views

In the interview, stakeholders were asked about the importance of engaging students with scientifically oriented questions. In response to the question teacher3 asserted that,

I start the class with lesson related questions to engage the students with the lesson which are given at TE, these are all scientific question. For example, in my past class lesson 'What is the weight of matter? there are no questions given at TE, so I asked my own way-what is weight?

In the statement, T3 expressed prior knowledge exploring question as scientifically oriented question to engage students; that indicates T3 did not comprehend about engaging students with scientifically oriented question.

Besides, stakeholders were asked about the Information provided in TB and TE of engaging students by scientifically oriented question. Among them PTI instructor3 said,

There are questions for prior knowledge exploration in TE and TB, if teacher do it accurately then it is possible to learn science through inquiry.

The statement expresses the unawareness of PTII3 about TB and TE, which reveal PTII3 did not comprehend the Information provided of inquiry-based learning in TB and TE.

In addition, when asked about the way of engaging students in lessons in science classroom; among stakeholders URC instructor3 replied,

Maximum time teacher conducts the class through textbook reading by the students; sometimes teacher explores students' prior knowledge through questioning that helps the teacher to engage the students with lesson.

In the statement, URCI3 mentioned prior knowledge exploring question for engaging students in science learning, which expressed lack of knowledge about inquiry-based learning. URCI3 did not comprehend the practice of engaging students in scientifically oriented questions.

Students' response in FGD

Students of FGD were asked about the way of engaging students in lessons in the science classroom. Their common response was, usually their class starts with reading text from books. One of them stated that

Teacher instructs us to read the textbook, one of us read and we all follow; sometimes teacher ask question, we answer, if we can't then sir reply us.

In the statement of the student, it asserts that the teacher did not engage the students focus on key question to conduct a lesson.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on key question to start a lesson. Key question is highlighted at the start of teaching learning activities of each lesson in TB (Figure 4.81). Whereas, it is placed after prior knowledge exploring question and lesson objectives related questions in teaching learning activities in TE (Figure 4.82). Therefore, this approach is extremely addressed in TB and TE.

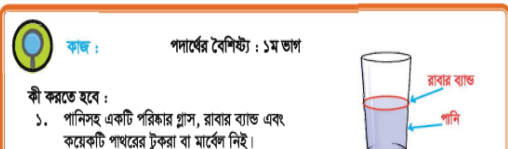
অধ্যায় ৬ পদার্থ আমাদের চারপাশে নানা কতু রয়েছে। যেমন— বই, খাতা, চেয়ার, টেবিল, জামা-কাপড়, ধূলিকণা, গাছপালা, পাহাড় ইত্যাদি। সকল কতুই পদার্থ দিয়ে তৈরি। ১. পদার্থের বৈশিষ্ট্য পদার্থের বিভিন্ন ধরনের বৈশিষ্ট্য রয়েছে। যেমন— ওজন, আয়তন, আকার, আকৃতি ইত্যাদি। প্রশ্ন : পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী? (১) আয়তন কাজ : পদার্থের বৈশিষ্ট্য : ১ম ভাগ কী করতে হবে : ১. পানিসহ একটি পরিষ্কার গ্লাস, রাবার ব্যান্ড এবং কয়েকটি পাখরের ঠিকরা বা মার্বেল নিই। 	[ভূমিকা] ৫। প্রশ্ন করুন : পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী? ৬। শিক্ষার্থীদের কাছ থেকে উত্তর পাওয়ার জন্য ন্যূনতম ৫ থেকে ৭ সেকেন্ড অপেক্ষা করুন। ৪/৫ জন শিক্ষার্থীর উত্তর শুনুন। (যদি কোনো শিক্ষার্থী স্বতঃস্ফূর্তভাবে উত্তর না দেয় তাহলে ১ জন শিক্ষার্থীকে নির্বাচন করে তাকে উত্তর দিতে সাহায্য করুন।) ৭। শিক্ষার্থীদের উত্তরের প্রেক্ষিতে অন্যান্য শিক্ষার্থীদের মতামত দিতে বলুন। ৮। শিক্ষার্থীদের উত্তরের সূত্র ধরে পাঠের উদ্দেশ্য ব্যাখ্যা করুন : “আজ আমরা পদার্থের বৈশিষ্ট্য নিয়ে আলোচনা করব। পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী? এটিই আমাদের আজকের পাঠের মূল প্রশ্ন। বিভিন্ন কাজের মাধ্যমে আমরা এই প্রশ্নটির উত্তর খুঁজব।” ৯। মূল প্রশ্ন বোর্ডে লিখুন : পদার্থের সাধারণ বৈশিষ্ট্যগুলো কী?
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Figure 4.81: Reflection of scientifically oriented question in TB

Figure 4.82: Reflection of scientifically oriented question in TE

A summary of the findings of document analysis, lesson observation and stakeholders' comprehension on engaging students by scientifically oriented questions are presented in the table.

Table 4.101: Summary of findings about engaging students by scientifically oriented questions

Stakeholders	stakeholders' comprehension of engaging students' by scientifically oriented questions			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About the importance of engaging students	About the information provided in TE & TB	About the way of engaging students				In TB	In TE
Teacher	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lesson: 1	lessons-1: Did not practice	Extremely addressed	Extremely addressed
PTI	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lessons: 2	lessons-2: Did not practice	Extremely addressed	Extremely addressed
URC	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lessons: 3	lessons-3: Did not practice	Extremely addressed	Extremely addressed
AUEO	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lesson:4	lessons-4: Did not practice	Extremely addressed	Extremely addressed
					Chapter: 6 Lesson: 5		Extremely addressed	Extremely addressed

The table indicates that curriculum documents adequately addressed the scientifically oriented question in all the observed lessons. In addition, T3 did not engage the students with scientifically oriented questions in classroom. Moreover, stakeholders did not comprehend its importance, the information provided in TE and TB, and the way of engaging students with the question. On the whole, stakeholders did not comprehend engaging students with scientifically oriented questions.

➤ Overall remarks

Curriculum documents have adequately addressed about the information of inquiry.

However, stakeholders along with the teacher do not comprehend curriculum documents approach and finally, it is reflected in the teacher's classroom practice as T3 did not focus on the first step of inquiry-based teaching.

4.15.2 Step-2. Students give priority to evidence in responding to these questions

Teacher's classroom practice

It has been explored from the observed lessons of T3 that, T3 did not give students any opportunity to do the activities and collect data. An observed lesson of T3 is shown in the table where T3 did not form groups with students, has given a few samples for activity-1 and only 2/3 of students did the activity randomly. Therefore, students did not get the opportunity to collect data.

Table 4.102: Teacher 3's classroom practice about giving students priority to evidence in responding to the question

Grade & Chapter	LO	Lesson mentioned in TE	Class taken by the teacher	scopes mentioned in TB and TE	teachers' activity in classroom
Grade-4, Chapter-6: 'Matter'	16.2.3 16.3.1	3	What is air? properties of air: 1 st part	3	Instructions have been given for the activity

Stakeholders' views

Stakeholders were asked, about giving students priority to evidence in responding to the question. The teacher3 said,

Students try to give answer from their daily-life experience. If they fail or need help to answer then I explain it as they do not know earlier. For example, in my past class the experiment of 'Air takes up space', students could not answer what will be happened if they do not do it earlier. Then I explain them.

In the statement it explores that T3 did not comprehend giving students priority to evidence in responding to the question.

Stakeholders were asked, about the information provided in TE and TB about giving students priority to evidence in responding to the question. PTI instructor3 said,

There is instruction for the teacher in all the lessons of TE and TB that, they can play as a facilitator, so the teacher explains to them the content related Q-A as students do not know about the matter and cannot give answer.

The above statement expressed that, PTII3 did not comprehend the information provided in TE and TB about giving students priority to evidence in responding to the question.

Stakeholders were asked, about the classroom practice of giving students priority to evidence in responding to the question. Teacher 3 said,

The students do not know the lesson content earlier. So, they try to give the answer and but I help them and give the answer first.

In the statement, it reveals that T3 did not know about the classroom practice of giving students priority to evidence in responding to the question.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE) it is found that, there is scope for the students to collect evidence in responding to scientific questions (Figures 4.83 & 4.46).

পদার্থ ৪৪

২. বায়ু কী?
আমরা বায়ু দেখতে পাই না কিন্তু বায়ু আমাদের চারপাশে আছে। বায়ু যখন প্রবাহিত হয় তখন আমরা তা অনুভব করতে পারি। গাছের ডালপালা ও পাতার নড়াচড়া দেখে আমরা বুঝতে পারি যে বায়ু প্রবাহিত হচ্ছে।

প্রশ্ন : বায়ুর বৈশিষ্ট্যগুলো কী?

কাজ : বায়ুর বৈশিষ্ট্য : ১ম ভাগ

কী করতে হবে :

১. ২টি পরিষ্কার কাচের গ্রাস ও একটি কাচের বা প্লাস্টিকের পানিপূর্ণ পাত্র নিই।
২. একটি গ্রাস পানিপূর্ণ পাত্রে এমনভাবে ডুবাই, যাকে গ্রাসের ভিতর পানি প্রবেশ করতে পারে।
৩. গ্রাসটিকে পানির ভিতর উলটা করে ছবিতে ধরে রাখি।
৪. দ্বিতীয় গ্রাসটিকে উলটা করে চাপ দিয়ে পানির ভিতর প্রবেশ করাই।
৫. দ্বিতীয় গ্রাসটিকে ঠিক প্রথম গ্রাসটির নিচে নিয়ে সামান্য কাত করি, যাকে দ্বিতীয় গ্রাসের বাতাস প্রথম গ্রাসে যেতে পারে।
৬. গ্রাস দুইটির মধ্যে কী পরিবর্তন হচ্ছে তা লক্ষ করি এবং ফলাফল খাতায় লিখি।



Figure 4.83: Reflection of activity for the students in TB

[একক কাজ]

৮। কীভাবে (বায়ুর বৈশিষ্ট্য : ২য় ভাগ) কাজটি করবে সে সম্পর্কে শিক্ষার্থীদের স্পষ্ট নির্দেশনা দিন "কোলানো ও চুপসানো দুটি বলেই চাপ প্রয়োগ কর ও আঘাত কর। কাজটি থেকে যা পর্যবেক্ষণ কর ও বুঝতে পার তা খাতায় লিখে রাখ।"

শিক্ষক সংস্করণ ১৫০ চতুর্থ শ্রেণি

প্রাথমিক বিজ্ঞান

৯। শিক্ষার্থীদের কাজটি করতে বসুন।

১০। শ্রেণিকক্ষ ঘুরে শিক্ষার্থীদের কার্যক্রম পর্যবেক্ষণ করুন এবং প্রয়োজনীয় সহায়তা দিন।

☐ মূল্যায়ন : শিক্ষার্থীরা ফুটবল দুইটির তুলনা করে পরীক্ষার ফলাফল সংরক্ষণ করেছে কিনা তা যাচাই করুন।

- ➔ দৃষ্টিভঙ্গি : স্বতঃস্ফূর্ততা, সক্রিয়তা, কৌতূহল
- ➔ প্রক্রিয়াকরণ দক্ষতা : তুলনাকরণ, পর্যবেক্ষণ

১১। শিক্ষার্থীরা তাদের খাতায় পরীক্ষার ফলাফল সংরক্ষণ করেছে কিনা, তা যাচাই করুন।

Figure 4.84: Reflection of activity for the students in TE

A summary of the findings of document analysis, lesson observation and stakeholders' comprehension of giving students priority to evidence in responding to the question are

presented in the table.

Table 4.103: Summary of findings about giving students priority to evidence in responding to the question.

Stakeholders	stakeholders' comprehension of giving students priority in responding to the question			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About the importance of engaging students	About the information provided in TE & TB	About the way of engaging students				In TB	In TE
Teacher	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lesson: 1	lessons-1: Did not practice	Moderately addressed	Moderately addressed
PTI	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lessons: 2	lessons-2: Did not practice	Moderately addressed	Moderately addressed
URC	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lessons: 3	lessons-3: Did not practice	Moderately addressed	Moderately addressed
AUEO	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lesson:4	lessons-4: Did not practice	Moderately addressed	Moderately addressed
					Chapter: 6 Lesson: 5		Moderately addressed	Moderately addressed

The findings of the table reveal that T3 did not comprehend giving students priority to evidence in responding to the question. However, concerned stakeholders have somewhat comprehension; but one of them did not comprehend. T3 somewhat engages students in responding to the question. The information is extremely addressed in TB and in TE.

➤ Overall remarks

The teacher did not comprehend about engaging students in responding to the question, and this was reflected in T3's classroom practice. The comprehension of concerned stakeholders may be reflected in the teacher's comprehension and classroom practices.

4.15.3 Step-3. Students formulate explanations from evidence

Teacher's classroom practice

It has been explored from the observed lessons that, the teacher did activities on own in front of the class. Students did not get the opportunity to see or do the activity by their own. As a result, they could not collect data to make an explanation from the evidence. The table 4.104 shows the teacher's classroom practice to formulate an explanation from the evidence by the students.

Table 4.104: Teacher 3's classroom practice about formulating explanations from evidence by the students

Grade & Chapter	LO	Lessons mentioned in TE	Lessons taken by the teacher	scope mentioned in TB & TE to formulate explanations from evidence	teachers' activity in classroom
Grade-4, Chapter-6: 'Matter'	16.1.1 16.1.2	2	Lesson-2	-Group discussion -Make summary	-Teacher explain the activity -instruct them to write with group discussion from book

Stakeholders' views

Stakeholders were asked, to formulate explanations from evidence by the students. Teacher3 said,

Though students do not know the lesson or content earlier, they cannot give explanation from the evidence or experiment; so I have to explain the matter. For example, in lesson 'volume of matter' students can answer what will happen after putting the stone into a glass of water but can't explain its cause.

The statement reveals that T3 did not comprehend the formulation of explanations from evidence by the students.

Stakeholders were asked, about the information provided in TE and TB to formulate explanations from evidence by the students. URC instructor3 said,

There is instruction at TB and TE for teaching learning activities, but our teacher do not understand it and follows it that way, at first students cannot give their explanation but after the teacher's explanation they can do it.

The statement reveals that URCI3 did not comprehend the information provided in documents for the formulation of explanations from evidence by the students.

Stakeholders were asked, about the classroom practice of formulating explanations from evidence by the students. Teacher3 said,

Most of the time students cannot give explanation of their answer from evidence as they do not know about the lesson earlier and cannot link the topic with the activity. They only say about the experiment that they have seen around them and I try to explain the answer. For example, which soil

contains much water? They can reply but cannot explain the reason because they do not know about soil characteristics that way.

The statement reveals T3 did not comprehend the classroom practice of formulation of explanations from evidence by the students.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is an opportunity for the students to formulate explanation of the scientific question through activity (Figures 4.85 & 4.86).

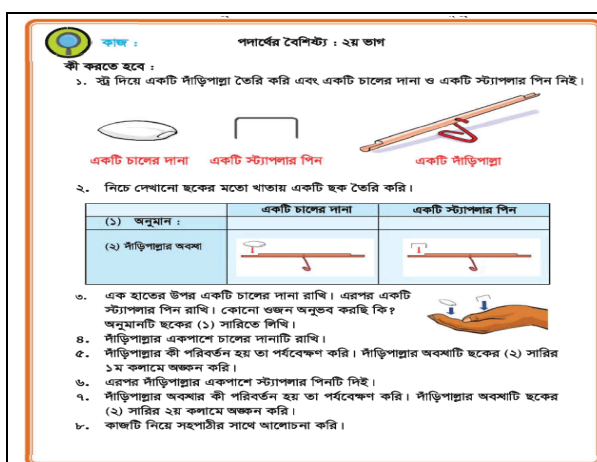


Figure 4.85: Reflection of the scope of formulated explanation in TB

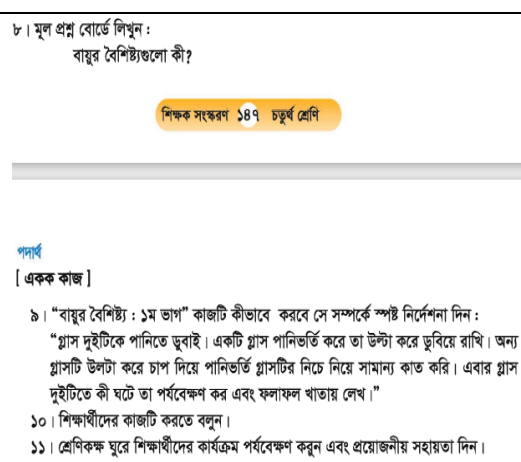


Figure 4.86: Reflection of the scope of formulated explanation in TE

The next table presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of formulating explanation.

Table 4.105: Summary of the findings about formulating explanation from evidence by the students

Stakeholders	Stakeholders' comprehension of formulating explanation by the students			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About the importance of engaging students	About the information provided in TE & TB	About the way of engaging students				In TB	In TE
Teacher	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lesson: 1	lessons-1: Did not practice	Moderately addressed	Moderately addressed
PTI	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lessons: 2	lessons-2: Did not practice	Moderately addressed	Moderately addressed
URC	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lessons: 3	lessons-3: Did not practice	Moderately addressed	Moderately addressed

Stakeholders	Stakeholders' comprehension of formulating explanation by the students			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About the importance of engaging students	About the information provided in TE & TB	About the way of engaging students				In TB	In TE
AUEO	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lesson:4	lessons-4: Did not practice	Moderately addressed	Moderately addressed
					Chapter: 6 Lesson: 5		Moderately addressed	Moderately addressed

The findings of the table reveal that, T3 and concerned stakeholders did not comprehend about formulating explanation from evidence by the students. T3 did not engage students to formulate explanation from evidence. The information is moderately addressed in TB and in TE.

➤ Overall remarks

The teacher did not comprehend formulating explanation from evidence by the students, and this was reflected in T3's classroom practice. The comprehension of concerned stakeholders may be reflected in the teacher's comprehension and classroom practices.

4.15.4 step-4. Learners evaluate their explanations in light of alternative explanations

Teacher's classroom practice

It has been explored from the observed lessons that, after doing the activity by own self, the teacher explains the activity; filled the provided blank table on the board by own self, and directs the students to read their books. Therefore, T3 gave students some opportunity to evaluate the explanation in light of alternative interpretations. A lesson exercise of T3 is shown in the next table.

Table 4.105: Teacher 3's classroom practice about evaluate students explanation in light of alternative explanations

Grade & Chapter	LO	Lessons mentioned in TE	Lessons taken by the teacher	Scope mentioned in TB to evaluate explanations in light of alternative explanations	Scope mentioned in TE to evaluate explanations in light of alternative explanations	Teachers' activity in classroom
Grade-4, Chapter-6: 'Soil'	16.2.3 16.3.1	3	3	Result is given after group discussion	-receive answer from each group -explain to them -instruct them to read lesson summary from book	Received group activity result which they wrote from TB

Stakeholders' views

To know about this, stakeholders were asked, about providing students the opportunity to evaluate their explanations in light of alternative explanations. Teacher3 said,

To evaluate students, I have to explain them the content or experiment result, then sit them into group to write the answer with group discussion, then receive answer from each group and the others hear.

The statement reveals T3 did not comprehend giving students opportunity to evaluate their explanations in light of alternative explanations.

Stakeholders were asked, about the information providing students opportunity to evaluate their explanations in light of alternative explanations. URC instructor3 said,

There is instruction at TB and TE for teaching learning activities, it is said that teacher facilitates the students, so they explain the content or experiment because students cannot do it.

The statement reveals URCI3 did not comprehend the information providing students opportunity to evaluate their explanations in light of alternative explanations.

Stakeholders were asked, about the classroom practice of giving opportunity to evaluate their explanations in light of alternative explanations. AUEO3 said,

Teachers do not practice it in classroom. They ask question to the students, 2-3 students can reply or not, teacher does not give more attention to assessment, only reading is the main focus.

The statement reveals AUEO3 did not comprehend about the classroom practice of giving opportunity to evaluate their explanations in light of alternative explanations.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is given opportunities for the students to evaluate their explanation in light of alternative explanation (Figures 4.87 & 4.88).

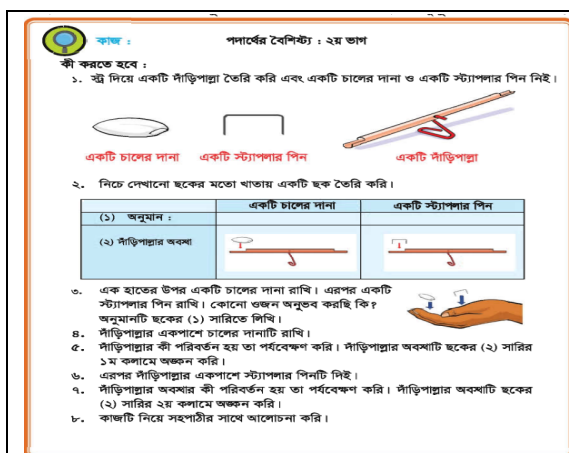


Figure 4.87: Reflection of opportunity to evaluate students' explanation in TB

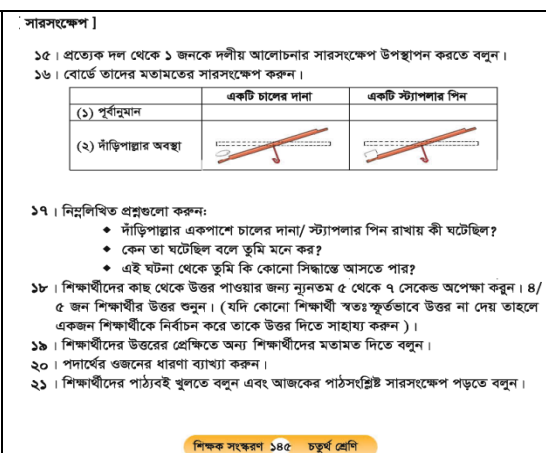


Figure 4.88: Reflection of opportunity to evaluate students' explanation in TE

The next table presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of giving opportunity to evaluate their explanations in light of alternative explanations.

Table 4.106: Summary of findings about evaluate learners' explanations in light of alternative explanations

Stakeholders	stakeholders' comprehension of giving opportunity to evaluate students' explanations in light of alternative explanations.			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About evaluate their explanations	About the information provided in TE & TB	About the practice of evaluate their explanations				In TB	In TE
Teacher	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lesson: 1	lessons-1: Did not practice	Moderately addressed	Moderately addressed
PTI	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter:6 Lessons: 2	lessons-2: Did not practice	Moderately addressed	Moderately addressed
URC	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lessons: 3	lessons-3: Did not practice	Moderately addressed	Moderately addressed
AUEO	Do not comprehend	Do not comprehend	Do not comprehend	Do not comprehend	Chapter: 6 Lesson:4	lessons-4: Did not practice	Moderately addressed	Moderately addressed
					Chapter: 6 Lesson: 5	Did not practice	Moderately addressed	Moderately addressed

The findings of the table reveal that T3 and concerned stakeholders did not comprehend giving opportunity to evaluate students' explanations in light of alternative explanations. T3 did not give opportunity to evaluate students' explanations in light of alternative explanations. The information is moderately addressed in TB and TE.

➤ **Overall remarks**

The teacher did not comprehend about the opportunity to evaluate students' explanations in light of alternative explanations, and this was reflected in T3's classroom practice. Concerned stakeholders also did not comprehend and this may be reflected in the teacher's comprehension and classroom practices

4.15.5 Step-5. Students communicate and justify their explanations

Teacher's classroom practice

It has been explored from the observed lessons that, after explaining the activity and filling the provided blank table on the board by own self, T3 directs the students to read their books. However, T3 did not form groups or directs the student' to form groups for group discussion. Therefore, students do not have the opportunity to communicate with each other and justify the explanation. A lesson exercise of T3 is shown in the next table.

Table 4.107: Teacher 3's classroom practice about students' communications and justify their explanations

Grade & Chapter	LO	Lessons mentioned in TE	Lessons taken by the teacher	Scope mentioned in TB to communicate with others and justify students' explanation	Scope mentioned in TE to communicate with others and justify students' explanation	Teachers' activity in classroom
Grade-4, Chapter-6: 'Soil'	16.1.1 16.1.2	1	Lesson-1	-	-ask lesson's key Q. -listen and justify their answers	-asked them lesson's key Q. - listened and justified their answers

Stakeholder' views

Stakeholders were asked about the students' communication with each other's and justified their explanations. The PTI instructor said

Students summarize the content through group discussion and share their answer with others through teacher's Q-A, thus their answer are justified

The statement explores that, PTII3 did not comprehend the students' communication with each other's and justify their explanations.

Stakeholders were asked about the information provided in TE and TB about the students' communication with each other's and justified their explanations. Teacher3 said,

I follow the instruction given at TE, all the thing I have done is instructed at TE, but in some cases I have to do my own way when I do not understand TE and TB information.

The statement explores that, T3 did not comprehend about the given approaches in TE and TB of students' communication with each other's and justify their explanations.

Stakeholders were asked about the classroom practice of students' communication with each other's and justify their explanations. Teacher3 said,

Actually, I told students to follow other's answer if she/he reply wrong answer, then directs to read the book and match the answer with TB content, they can't give their justification that way, so I receive answer from several students so that they can memorize it.

The statement reveals that, T3 did not comprehend classroom practice of students' communication with each other's and justified their explanations.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is given opportunities for the students to communicate with others and justify their explanation through group discussion (Figure 4.89 & 4.90).

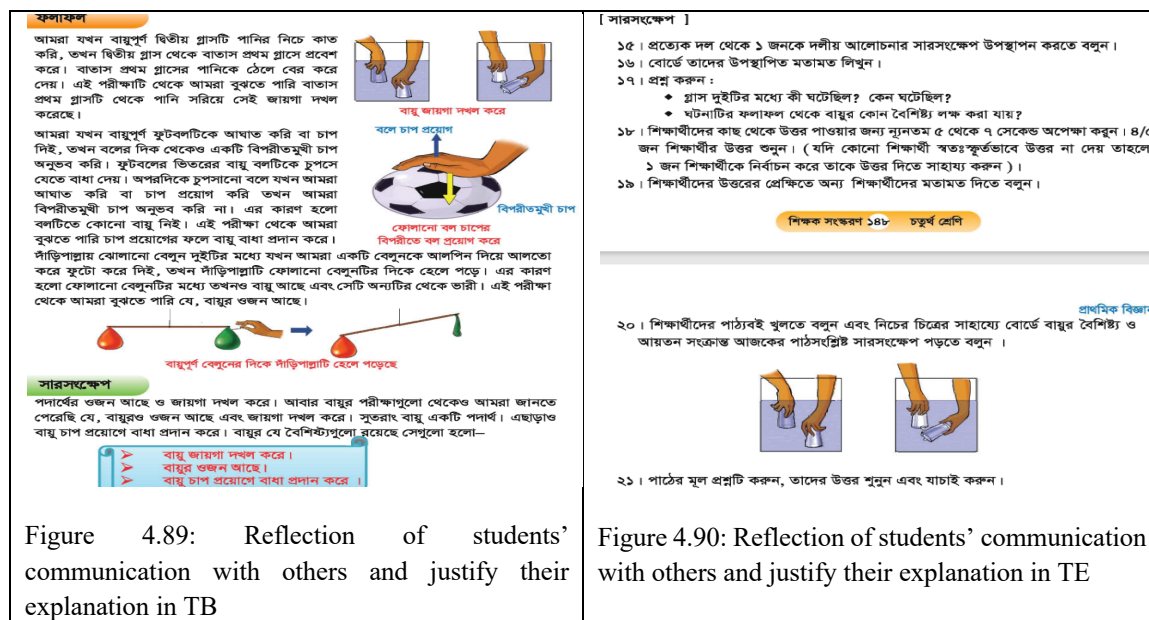


Figure 4.90: Reflection of students' communication with others and justify their explanation in TE

Table 4.108: Summary of findings about students' communication and justify their explanations

Stakeholders	Participants view about students' communication with each other's and justify their explanations			Overall comprehension	Chapter & lessons in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About evaluate their explanations	About the information provided in TE & TB	About the practice of evaluate their explanations				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:6 Lesson: 1	lessons-1: Did not practice	Somewhat addressed	Somewhat addressed
PTI	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter:6 Lessons: 2	lessons-2: Did not practice	Somewhat addressed	Somewhat addressed
URC	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lessons: 3	lessons-3: Did not practice	Somewhat addressed	Somewhat addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Chapter: 6 Lesson:4	lessons-4: Did not practice	Somewhat addressed	Somewhat addressed
					Chapter: 6 Lesson: 5		Somewhat addressed	Somewhat addressed

The findings of the table reveal that, T3 and concerned stakeholders did not comprehend about learners' communication with each other's and justify their explanations. T3 did not give opportunity to learners' communication with each other's and justify their explanations. The information is somewhat addressed in TB and in TE.

➤ Overall remarks

Teacher1's comprehension about giving opportunity to learners communicate with each other's and justify their explanations was reflected in T3's classroom practice. Concerned stakeholders' comprehension may also be reflected in the teacher's comprehension and classroom practices.

➤ Overall findings on given learning opportunities provided for inquiry-based teaching

Teacher4 did not comprehend inquiry approaches. T3's comprehension of inquiry was reflected in the classroom as T3 did not practice inquiry-based teaching in the science classroom. Students also revealed that teacher did not focus on inquiry approaches in the science classroom. Concerned stakeholders did not comprehend the inquiry approaches; that may be reflected in teachers' comprehension and classroom practices. Curriculum documents (TB & TE) mostly somewhat addressed the inquiry approaches.

4.16 Comprehension of Practiced Assessment Methods (formative and summary) to Assess ILOs

The following section presents the results of the comprehension of practiced assessment methods: summary and formative, through documents analysis, lesson observation and interviews.

4.16.1 Formative assessment: areas and tools

Provided information in Text Books, Teacher's Edition and Assessment Guide

It is clearly instructed at the start of the teacher's edition that, "conduct formative assessment of the student during and end of the lesson, and keep record according to assessment guide". However, the following table presents the data from documents analysis and lesson observations of assessment areas (cognitive knowledge, science process skills; scientific attitude and values) and assessment tools (Oral and written). Analyzing the primary science textbooks (TB), teacher's editions (TE) and assessment guide (AG) it is found that, the information provided for lesson-1 moderately addressed in TE following the AG instruction but did not address in TB that way.

Table 4.109: Information provided for formative assessment areas and assessment tools

Selected assessment areas, sub-areas and tools in Assessment Guide			Assessment focused at TE		Assessment focused at TB		Assessment practiced by the teacher					
areas	sub-areas	tools	Assessment areas	Assessment tools	Assessment areas	Assessment tools	Assessment areas	Assessment tools				
cognitive Knowledge	remembering	oral	Knowledge Understand	questions	-	-	knowledge	oral questions				
	understand	assessment checklist										
	application											
	higher order learning	written questions										
science process skills	observation	observation checklist	observation	observation			-	-	Observation	oral questions		
	measurement											
	classification	oral checklist	prediction						communication	written question		
	prediction											
	decision making	written questions	decision making									
	experiment											
	communication											
scientific attitude and values	Positive attitude	observation checklist	interest	observation					-	-		
	curiosity		Curiosity									
	open mindedness		open mindedness									

Selected assessment areas, sub-areas and tools in Assessment Guide			Assessment focused at TE		Assessment focused at TB		Assessment practiced by the teacher	
	curious on verification		curious on verification					
	interest							
	honesty							
	morality							
	creativity							

Teacher's classroom practice

In the table 4.110 it is found that T3 focused knowledge, observation and communication for assessment through oral and written questions in the lessons¹. T3 did not focus on any scientific attitude and values which are also mentioned in TE. Therefore, T3 somewhat practiced the mentioned assessment areas and tools.

Stakeholder' views about formative assessment method: areas and tools

At the beginning of teacher's edition there is an instruction for the teachers to determine assessment methods and tools for assessing the achieved ILO, so that students' competency can be assessed and possible necessary steps can be taken during formative assessment.

Formative assessment areas

stakeholders were asked about the formative assessment focus areas during classroom assessment. The PTI instructor³ said,

We always mention at training session that assessment must be focused on learning outcome which covers students' knowledge understand and application level of learning.

In the statement, PTII³ stated the focus areas for formative assessment where two basic focuses for science learning: skill and attitude are absent. This statement indicated that PTII³ has somewhat comprehension of the focus areas for formative assessment.

To know stakeholders' knowledge about the information provided in documents, they were asked about the scopes of assessment areas on given activities in TE and TB with examples. Teacher³ said,

There is no question for classroom assessment at TB, there are some questions at the end of each lesson at TE that I ask them to know their

knowledge level. For example, in lesson 'Matter' there is a Q. at TE what are the properties of matter? I instructed them to write.

The explanation reveals T3's unawareness about the information provided in the documents, as T3 did not follow TE and TB, and did not understand that way.

Stakeholders were asked about teachers' classroom practice of formative assessment areas. The URC instructor3 said,

At classroom teacher only focuses students' knowledge level, they do not focus on others like understand and application level.

In the statement, it reveals that URCI3 has somewhat comprehension of the assessment focus areas.

Formative assessment tools

stakeholders were asked about the scope of assessment tools in the provided activities of TE and TB. Teacher3 said,

Actually, I become so busy with my class and other school based activities that I could not get chance to see the TE and TB accordingly.

Here, the unawareness of T3 is explored in the above statement, as T3 only follows TB for classroom assessment. However, guidelines for classroom assessment are clearly provided in TE and AG. Hence, T3 has somewhat comprehension of classroom assessment tools.

stakeholders were asked about the assessment tools practice in classroom. URC instructor3 said,

The teacher usually uses oral question for assessment. They did not fully assess the students and said-how could i reach each and every student? They ask the students questions, only selective 2 or 3 can give the correct answer. The teacher did not show any interest in the other students and thought assessment have been completed.

In the statement it reveals that, URCI3 has somewhat comprehension of the classroom assessment process. A summary finding of stakeholders' comprehension of formative assessment method is presented in table 4.711 next.

Table 4.110: Stakeholders' comprehension about formative assessment methods

Stakeholders' comprehension about formative assessment: areas and tools						Overall comprehension of formative assessment areas and tools
Stakeholders	Areas of formative assessment	Information of formative assessment areas in TB & TE	Views about classroom practice of assessment areas	Information of formative assessment tools in TB & TE	Views about classroom practice of assessment tools	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table reveals that, teacher and concerned stakeholders have somewhat comprehension about the areas and tools of formative assessment. However, they also have somewhat comprehension about TB and TE provided information. Moreover, teacher and concerned stakeholders have somewhat comprehension about classroom practice of formative assessment areas and tools.

The summary of findings about the information provided in TB and TE; and level of T3's practiced assessment methods in the classroom and stakeholders views are shown in the table.

Table 4.111: Summary of findings about formative assessment methods

Stakeholders	Stakeholders' comprehension of formative assessment methods			Overall comprehension of assessment methods	Chapter, Lesson & No. of ILO in Grade three	Teacher's lesson practice	Information provided (Based on literature Review)		
	About areas of formative assessment	About given Information in TB & TE	About way of classroom assessment				In TB	In TE	In AG
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 1	Lesson-1: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 2	Lesson-2: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 3	Lesson-3: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Chapter: 6 Lesson: 4	Lesson-4: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
					Chapter: 6 Lesson: 5		Somewhat addressed	Somewhat addressed	Somewhat addressed

It is found from table that, teacher and concerned stakeholders have somewhat comprehension of formative assessment methods. It also explores that, T3 somewhat practiced formative assessment, as T3 did not focus on assessment areas and did not

practice assessment tools as such in the classroom. The information on formative assessment areas and assessment tools are somewhat addressed in AG, TE, and TB.

➤ **Overall remarks**

The teacher has somewhat comprehension about formative assessment methods, and this was reflected in T3's classroom practice. Concerned stakeholders also have somewhat comprehension; and this may be reflected in the teacher's comprehension and classroom practices. Curriculum documents addressed somewhat, and this may be also reflected in teacher and concerned stakeholders' comprehension and teacher's classroom practice.

4.16.2 Summary assessment: areas and tools

Stakeholder' views about summary assessment

To know stakeholders' view they were asked about the areas of summary assessment. Teacher3 said,

I do not get opportunity to develop questions, usually experienced master trainers do it centrally in groups in I do assess the exam sheets following the areas and number mentioned in question.

The statement reveals that T3 did not get the opportunity to develop summary assessment question. Therefore, T3 has somewhat comprehension about the areas of summary assessment.

In response to a question asked about the instructions given in the documents (TE, TB & AG) specifying the areas of summary assessment areas, URC instructor3 replied,

There are questions in the end of each chapter in TB and TE; but no other instruction was provided regarding summary assessment, the teachers follow the marking scheme provided by NCTB to assess the answer script.

In the statement, it reveals that URCI3 was unaware about the assessment instruction and has no idea about assessment guide. URCI3 also stated marking scheme for assessment instruction. URCI3 did not know the instruction provided in documents for summary assessment. Stakeholders were asked about the development of summary assessment question.

Upazila consists a committee with expert person to prepare question centrally; The teacher assesses the answer sheet following marking scheme or sometimes we instruct them to prepare their own marking scheme following NAPE.

In the statement it reveals that only a few selective expert persons are involved in developing summary assessment question. AUEO3 did not engage in developing question but have some knowledge about the development of summary assessment question.

A summary finding of stakeholders' comprehension about summary assessment method is presented in the next table 4.113, where areas of assessment, information provided in documents and development process of assessment question are included.

Table 4.112: Stakeholders' comprehension about summary assessment method

Stakeholders' comprehension about summary assessment method				Overall comprehension
Participants	Focusing areas of assessment	Information provided at documents about assessment areas	Development of summary assessment question	
Teacher	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

It reveals from the table that the stakeholders have moderate comprehension about areas of assessment; moreover, they have somewhat comprehension about the provided information in the documents and question development. Therefore, the stakeholders were somewhat comprehend about summary assessment method.

➤ Overall remarks

The practiced summary assessment question did not follow the instruction given in the documents. Although the academic supervisors did not have the opportunity to be involved in the question development, however they were somewhat comprehend about summary assessment method. Moreover, T3 also did not have the opportunity to be involved in the question development. These all reflected on the comprehension of T3, as T3 was also somewhat comprehend about summary assessment method.

Practiced summary assessment question in the school

The collected summary assessment question is analyzed focusing on areas and tools, and the findings is presented in the table 4.114 next.

Table 4.113: Practiced assessment areas and tools

Types of questions	Cognitive knowledge								Total no of Q.	Total number of Q.
	Remembering		Understanding		Applying		Higher order learning			
	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.		
Short Q.	4	4×2=8	1	1×2=2	-	-	-	-	5	10
Fill in the blanks	10	10×1=10	-	-	-	-	-	-	10	10
Matching	5	5×2=10	-	-	-	-	-	-	5	10
Narrative Q.	5	5×10=50	-	-	2	2×6=12	1	1×8=8	8	70
Total number	-	78 (78%)	-	(2%)	-	12 (12%)	-	8 (8%)	28	100

The table 4.114 reveals that, the practiced summary assessment numbers covered maximum almost 78% numbers focusing remembering whereas, higher order thinking covered only almost 8%. There are found anomaly in question, where 5 questions within 28 was repeated. However, there is no marks distribution for fraction of questions in narrative part, which can confuse teachers to mark against each question.

The findings of analyzed summary assessment question, and the information provided by NCTB and assessment guide (AG) for preparing summary assessment questions are presented in the next table.

Table 4.114: Provided areas and percentage of summary assessment method

Areas and percentage of knowledge for summary assessment			
Areas of knowledge	% of practiced questions	proposed % from NCTB	Proposed % from assessment guide
remembering	78	20	30
understanding	2	30	30
applying	12	30	30
HOT	8	20	10

In the table 4.115 it is explored that, maximum % (78) question was from remembering and minimum % (8) question was from higher order thinking (HOT) in practiced summary question. However, there is a big gap in remembering (78%) and understanding (2%) areas in the analyzed question. NCTB suggested 20% and assessment guide (AG) suggested 30%

questions from remembering. In case of understanding, both NCTB and AG suggested 30 % questions. Therefore, the practiced summary question did not follow the provided instructions for preparing questions.

➤ **Overall remarks**

Teacher and concerned stakeholder did not have the opportunity to be involved in the summary assessment question development. However, they were somewhat comprehend about summary assessment method. The practiced summary assessment question did not follow the instruction given in the documents; and this may be reflected in teacher and concerned stakeholders' comprehension. Teacher and concerned stakeholder have somewhat comprehend about assessment methods. Stakeholders' comprehension may be reflected in teacher's comprehension and practice.

4.17 Comprehension about the Extent of Students' Achievement of ILO

4.17.1 The extent of students' achievement of ILOs by formative assessment

Stakeholders view about the extent of students' achievement of ILOs

To know the stakeholders' view, they were asked 'How to understand to what extent the ILOs have been achieved during conducting lessons. The PTI instructor³ said,

Students' response during class time makes the teachers understand that how much students' LO has been achieved. The teachers can take further steps accordingly.

In the statement PTII³ states that, PTII³ have somewhat comprehension about the extent of students' achievement of ILOs.

To know stakeholders' views, they were asked about the information provided in AG, TB and TE to assess the extent of achieving the ILOs through formative assessment. in response the AUEO³ said,

Teachers do it in class with the questions provided in TB and TE or they create their own questions and evaluate the students in class. We have also formatted structure for classroom assessment.

In the statement of AUEO3 it reveals that AUEO3 were moderately comprehend about the information provided in documents.

To know the classroom practice, stakeholders were asked about the practice to assess the extent of students' achievement of the ILOs through formative assessment. Teacher3 stated,

Students' achievement can be known by question-answer during class time focusing knowledge, understand and application. We do not have any system to give them marks for formative assessment. If they can't answer then it is clear that they completely fail to achieve the ILO.

In the statement T3 explained the way of assessing the extent to achieve the ILOs during conducting lesson without following any given instruction or format. This explanation revealed the unawareness of T3, from which it can be understood that T3 were somewhat comprehend about formative assessment.

A summary of findings is presented in the next table 4.116, where stakeholders' comprehension of the extent of students' achievement of ILOs by formative assessment.

Table 4.115: Summary of findings of stakeholders' comprehension about the extent of formative assessment.

Stakeholders	Stakeholders view about the extent of achieving the ILOs through formative assessment			overall comprehension about the extent of ILO achievement through formative assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE about formative assessment extent	Practice of the extent of ILO achievement	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Moderate comprehend	Moderate comprehend	Moderate comprehend
AUEO	Moderate comprehend	Moderate comprehend	Moderate comprehend	Moderate comprehend

From the table, it states that teacher and one concerned stakeholder have somewhat comprehension about the extent of students' achievement of ILOs by formative assessment. However, two concerned stakeholders have moderate comprehension.

4.17.2 The extent of ILOs achievement by summary assessment

Stakeholders view about the extent to which ILOs has been achieved

Stakeholders were asked ‘How to understand to what extent the ILOs have been achieved through summary assessment? The URCI3 said,

The focus of summary assessment is knowledge, understanding and application. Marking skim is followed to prepare question. So, teachers assess answer script following marking skim.

In the statement URC3 stated about the summary assessment methods, that reveals URCI3’s moderate comprehension about the extent of students ILO achievement by summary assessment.

Stakeholders were asked about the information provided in AG, TB and TE to assess the extent of students learning for achieving the ILOs. AUEO3 instructor said,

There are questions in the end of each chapter in TB and TE for summary assessment. Teacher assesses the answer script following the marking skim provided by NAPE or the given number against each question in the question paper.

In the statement it explores that AUEO3 has moderate comprehension about the extent of students ILO achievement by summary assessment.

Stakeholders were asked about the practice of achieving the extent of ILOs through summary assessment. Teacher3 said,

I follow number against each question to assess. For example, knowledge-based answer is for one number, understand based answer is for 2 number and application based answer is for 3/4 number. If the students can give answer accurately, gets the full marks; if can’t then get less marks.

The statement explores the summary assessment process of T3, where T3 follow the instruction given in question to asses answer script. Hence, T3 has somewhat comprehension.

A summary of the findings of stakeholders’ comprehension about the extent to which ILOs has been achieved by summary assessment is shown in the next table 4.117.

Table 4.116: Summary of findings on stakeholders' comprehension about the extent to achieve the ILOs by summary assessment.

Stakeholders	Stakeholders view about the extent of students ILO achievement by summary assessment			overall comprehension about the extent of students ILO achievement by summary assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE	Teacher's assessment system	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Somewhat comprehend	Moderate comprehend	Moderate comprehend
AUEO	Moderate comprehend	Somewhat comprehend	Moderate comprehend	Moderate comprehend

From the table it states that, teacher and one concerned stakeholder have somewhat comprehension about the extent of students' achievement of ILOs by summary assessment. However, two concerned stakeholders have moderate comprehension.

➤ Overall remarks

Teacher has somewhat comprehension about the extent of students' achievement of ILOs by both the formative and summary assessment. Concerned stakeholders have somewhat to moderate comprehension in both the assessment; and this may be reflected in teachers' comprehension and practices.

➤ Overall remarks on the extent of students' achievement of ILOs

Teacher has somewhat comprehension about the extent of students' achievement of ILOs. Mostly, concerned stakeholders have moderate comprehension; that may be reflected in teachers' comprehension and practices.

4.18 Challenges to Practice Inquiry in the Science Classroom

Challenges of practicing inquiry in the science classroom

This study finds the most significant challenges from case A to the successful implementation of inquiry-based teaching in teacher and concerned stakeholders' interview sessions and these are presented in the next.

1. Perspectives on the meaning of inquiry-based teaching instruction

The perception of inquiry-based teaching instruction is a major concern that which activities do, and which do not create inquiry instruction. Bell et al. (2005) stated that

students' activities may be simply referred to as hands-on activities rather than an inquiry when they are not engaged in the analysis of data to generate the question answer. In the interview session, URC Instructor3 said,

Inquiry is learning with doing, students will learn science concepts with activities, but our teacher does not engage them in hands-on activities.

PTI Instructor said,

Students learn science with activities on their own, they engage in a hands-on activity, this is inquiry in science learning.

In the statements, it reveals that there are different perspectives on the meaning of inquiry-based teaching instruction.

In the statements of the teacher and concerned stakeholders, it reveals that they have different perspectives on the meaning of inquiry-based teaching instruction rather than the actual meaning.

2. The divergent perspectives of what constitutes appropriate guidance of inquiry

The most rational level of appropriate guidance must reflect in the inquiry process with a balance between learners and teachers, and the level of guidance and support depend on who is responsible for the inquiry activity. The instructor who becomes a facilitator in inquiry teaching may provide vital kick-starter guidance on a minimal scale that is appropriate to learners (Blanchard et al., 2010). In the interview session T3 said,

The students of elementary level are too young to do an activity, they cannot read properly, so how could they do an activity in the classroom. I try to do the activity and they see it.

AUEO3 said,

Students of the primary level cannot read that way, so what will we do with science learning, so teachers do not do activities, and conduct the class by reading the book.

In the statements, divergent perspectives explore on what constitutes appropriate guidance of inquiry.

3. Classroom management

Classroom assessment is a concern for inquiry learning. URCI3 stated,

Doing activity-based classes with large numbers of students is a big challenge for teachers; besides this, the seating arrangement, and classroom space are not suitable for activity-based classes in most of the schools.

AUEO3 asserted,

Classroom management like the formation of students groups, keeping them on task, and observing their work there is very difficult and time-consuming for the teacher, especially with large class sizes.

In the statements, it reveals that teachers faced difficulty to practice inquiry because of classroom management.

4. Curriculum design and infrastructure

Curriculum design and the infrastructure of the schools need to align for implementing curriculum instruction. The physical and human resources of the school, seating arrangement, and sufficient place all are important to implement curriculum instruction.

T3 claimed,

Maximum time I cannot connect the Tb and TE instruction with my class, as I have to manage a large class size. The classroom as well as the school environment is not suitable for all the activities to do that instructed in the TB and TE.

PTII3 said,

The instruction for activity-based classes of TB and TE must be aligned with the school's environment. But our maximum schools do not have many facilities in structure and resources, and teachers do not want to manage anyhow to do activity-based class.

In the statements, it reveals that teachers faced difficulty to practice inquiry because of curriculum design and institutes infrastructure.

5. Lack of collegial supervision

Senior teachers could provide empirical advice to others with their teaching experiences, content, and pedagogical expertise. School authorities, as well as teachers, formed formal and informal learning communities with colleagues to exchange teaching ideas. PTII3 said,

Sharing with others is a good practice for learning, we can learn from our senior or junior teacher. But teachers cannot want to share with another colleague due to their shyness.

AUEO3 asserted,

Our teacher cannot connect curriculum instruction with classroom activities. The infrastructure of schools does not support curriculum instruction. The teacher does not get interested to do an activity, and does not get ready to manage the activity class.

The statements disclose that collegial supervision play a vital role for prating inquiry.

6. Insufficient guides for connecting curriculum and inquiry teaching

To implement inquiry-based teaching, there needs sufficient guidance for connecting curriculum and inquiry. Teaching learning activities of science curriculum is designed with the following inquiry. In the interview session teacher3 said,

I do not understand inquiry that way. Though I have PTI training this is not sufficient for me to understand all the approaches of textbooks and teacher's editions.

AUEO3 asserted,

Our teacher cannot connect curriculum instruction with classroom activities. Though they have the training they are not subject-based teachers. The teacher who conducts science needs specific training on curriculum instruction and the inquiry for science teaching, otherwise, they cannot do inquiry in the classroom.

The statements reveal that insufficient guides for connecting curriculum and inquiry teaching prevent inquiry teaching.

7. Management of extended activities

Students need not do any extended complex processes as part of traditional learning activities. So, if they are unable to organize or manage any extended process for inquiry, they cannot engage in inquiry properly and cannot achieve the goal of inquiry-based learning. PTII3 said,

Sometimes it needs more than simple skills to do activities in science classes. So it is challenging for teachers to manage the activities in a simple way.

URCI3 said,

Teachers do not do simple activities in science classes. If it is a matter of complex activity, students become worried and teachers lose their interest to manage the activity.

The statements reveal management to extend the activity and prevent to do inquiry.

8. The practical constraints of the learning context

The technologies and activities of inquiry-based learning must suitable for the practical obstacle of the learning environment like available resources and fixed schedules (Edelson et al., 1999). The school environment, infrastructure, student cooperation, and available resources are most important for inquiry learning. T3 said,

If I want to follow the TB and TE instruction accurately, sometimes it is not possible for me to do activities in class. The resources, time schedule, other works in school, school environment, etc. many other things make problem to do activities.

AUEO3 asserted,

Students of elementary grades are large in number. It is tuff to engage a large number of students with activities in the science classroom. It needs sufficient time, instruments, sufficient space, sufficient cooperation to engage them in inquiry.

The statements reveal practical constraints of the learning context is a vital cause to do inquiry.

Case study D

In this case, teacher 4 was from a rural area. Concerned stakeholders were a few academic supervisors: PTI instructor, URC instructor, and AUEO, who are engaged in teachers' training, supervision, and monitoring. Some students of teacher 4 also participated in FGD. The following section explores the teacher and concerned stakeholders' comprehension of intended learning outcome, comprehension of the approaches of TB and TE; of the practiced learning opportunities; comprehension of the assessment methods; comprehension of the extent of students learning, and finally challenges to implement inquiry in science classroom.

4.19 Stakeholders' Comprehension about the Focus of ILOs

Teacher's classroom practice

It has been explored from the four observed lessons that the teacher 4 focused only knowledge level of ILO the other two focuses: skill and attitude are absent. Table 4.118 presents T4's lessons practice focusing on ILO.

Table 4.117: Teacher 4's classroom practice in Grade-4, Chapter-Plants and Animal

No of ILO	ILO in TE	Lessons in TE	Lesson title	Lessons taken by teacher1	Teacher's focus on ILO
2.2.1	will be differentiate between plants and animals	Lesson-1	Difference between plants and animal	Lesson-1	Focused only knowledge

Stakeholders' views

In response to the question 'What is intended learning outcome-explain with an example.' the T4 replied,

LO is the main thing for conducting class, which I keep in my mind or write on my diary before going to class. For example, LO of one of my classes was will be able to differentiate plants and animals, so I had to focus on plants and animals' characteristics.

The statement reveals that, T4's has somewhat comprehension of ILO.

In the interview, when asked ‘What are the importance of ILO focus-explain with example?’, the PTII4 stated,

The focus of LO is very important for students’ real life, it is according to Blooms Taxonomy and these are knowledge, understand and application for primary level. The focus on these three competencies is must for LO. Students have to achieve these competencies through teaching learning activities and have to apply these competencies in their real life.

In the statement, it reveals that PTII4 has somewhat comprehension of the importance of ILO focus. In response to the question ‘How did you identify the focus of ILO-explain with example?’ The URC instructor said,

The focus of LO is knowledge, understand and application. For example, when the students know about the ingredients of saline then it is knowledge level LO, when and where to apply it-it is understand level LO and finally when they can make it to see the patient then it is application level LO.

In the statement of URCI4, the common terms as ILO focus are knowledge, understand and application, which reveals URCI4 has somewhat comprehension about the identification of ILO focus.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher’s editions (TE), it is found that TB did not mention ILOs; and TE mentioned ILOs but did not address ILO focus.

অধ্যায় ২

উদ্ভিদ ও প্রাণী

১. উদ্ভিদ ও প্রাণীর মধ্যে পার্থক্য

উদ্ভিদ ও প্রাণী উভয়েই জীব। এদের মধ্যে কোনো পার্থক্য লক্ষ করেছ? আমরা কীভাবে উদ্ভিদ ও প্রাণীর মধ্যে পার্থক্য করতে পারি?

প্রশ্ন: উদ্ভিদ ও প্রাণীর মধ্যে কী কী পার্থক্য রয়েছে?

কাজ: উদ্ভিদ ও প্রাণীর বৈশিষ্ট্য

কী করতে হবে:

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

প্রশ্ন	উদ্ভিদ	প্রাণী
কীভাবে শক্তি পায়?		
কী কী অঙ্গ বা অংশ রয়েছে?		
কীভাবে চলাচল করে?		
কীভাবে সাদা প্রদান করে?		
আরও কিছু?		

উদ্ভিদ ও প্রাণী

অধ্যায় ২

উদ্ভিদ ও প্রাণী

অর্জন উপযোগী যোগ্যতা

২.১ বিভিন্ন জীব বিভিন্ন পরিবেশে বসবাস করে তা বুঝতে পারবে।
২.২ উদ্ভিদ ও প্রাণীর মধ্যে পার্থক্য জানবে।

শিখনফল

২.১.১ বিভিন্ন উদ্ভিদ ও প্রাণী বিভিন্ন পরিবেশে বসবাস করে তা বর্ণনা করতে পারবে।
২.১.২ পরিবেশের বিভিন্ন উদ্ভিদের বিভিন্ন ধরনের বৈশিষ্ট্য রয়েছে তা পর্যবেক্ষণ ও অনুসন্ধানের মাধ্যমে বর্ণনা করতে পারবে।
২.১.৩ পরিবেশের পরিবর্তনের ফলে কোন একটি নির্দিষ্ট পরিবেশের উদ্ভিদ ও প্রাণীর বিলুপ্তি ঘটে তা উল্লেখ করতে পারবে।
২.১.৪ পরিবেশে জীবের বিভিন্ন আবাসস্থল শনাক্ত করতে পারবে।
২.১.৫ বিভিন্ন উদ্ভিদের বিভিন্ন পরিবেশে প্রয়োজন তা বলতে পারবে।
২.১.৬ বিভিন্ন পরিবেশে যে সকল উদ্ভিদ জন্মে সেগুলো শনাক্ত করতে পারবে।
২.১.৭ বিভিন্ন প্রাণীর বিভিন্ন আবাসস্থল উল্লেখ করতে পারবে।
২.১.৮ একটি নির্দিষ্ট স্থানে উদ্ভিদ ও প্রাণীর উপরে সেই স্থানের পরিবেশের বিভিন্ন প্রভাব উল্লেখ করতে পারবে।
২.২.১ উদ্ভিদ ও প্রাণীর মধ্যে পার্থক্য করতে পারবে।

Figure 4.91: Reflection of ILOs in TB

Figure 4.92: Reflection of ILOs in TE

A summary finding of stakeholders' level of comprehension about the focus of intended learning outcome is presented in the table 4.119 next.

Table 4.118: Summary of findings on stakeholders' comprehension about the focus of ILOs in Grade-4 Chapter-Plants and Animals

Stakeholders	Stakeholders' view about focus of ILOs			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Meaning of ILO	Importance of ILO focus	Way of identify ILO focus				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-1 ILO: 2.21	lessons-1: somewhat practiced	Not addressed	Somewhat addressed
					Lesson-2 ILO: 2.1.1 2.1.5 2.1.6	lessons-2: somewhat practiced	Not addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3 ILO: 2.1.1 2.1.5 2.1.6		Not addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-4 ILO: 2.1.1 2.1.4 2.1.7	lessons-3: somewhat practiced	Not addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-5 ILO: 2.1.1 2.1.2 2.1.4 2.1.5 2.1.6 2.1.7	lessons-4: somewhat practiced	Not addressed	Somewhat addressed

The findings reveal that the teacher and concerned stakeholders have somewhat comprehension about the focus of ILOs. The teacher somewhat practiced ILO focus in the science classroom. ILOs did not address in textbooks (TB) and were somewhat addressed in teacher's edition (TE).

➤ Overall remarks

Teacher 4's comprehension of the focus of ILOs was reflected in T4's lessons practice. Concerned stakeholders' somewhat comprehension of the focus of ILOs may also be reflected in teacher's comprehension as they are engaged in teacher training, supervision and monitoring. The somewhat provided information in curriculum documents may also be reflected in concerned stakeholders' comprehension and T4's comprehension and lessons practice.

4.20 Stakeholders' Comprehension about the approaches of Primary Science Textbooks (TB) and Teacher's Edition (TE)

This section of the chapter presents teachers and stakeholders' comprehension of the approaches of textbooks and teacher's editions.

4.20.1 Starting lesson with a key question

Teacher's classroom practice

It has been explored from the four observed lessons that, the teacher started two classes with lesson title related songs, the two others with prior knowledge exploring question. After that the teacher started teaching learning activities and did not focus on key question. Moreover, teacher 4 conducted more than one lesson in one class. The next table presents the way of starting a lesson by teacher 4.

Table 4.119: Teacher 4's classroom practice about starting lesson with a key question in Grade-4, Chapter-Plants and Animal'

Grade & Chapter	ILO	Lesson in TE	Lesson title	Lesson taken by the teacher	Lesson objectives mentioned in TE & TE for key q. clue	Key q. mentioned in TE and TB	Teacher's focus on key question in classroom	Way of starting lesson by the teacher
G-4 C-2: plant and animal	2.1.1 2.1.5 2.1.6	2	Plants in nature	L-2	*Which plants grow in which habitat? *Where does plant grow in nature?	Where does plant grow?	did not mention	Sung a plant related song
	2.1.1 2.1.5 2.1.6	3	Plants in nature		Where do shapla, water hyacinth grow?	Where does plant grow in nature?	did not mention	

Stakeholders' views

To know the stakeholders' views, they were asked about the importance of key question to start a lesson. Among them T4 said,

It is very important. It helps me to know the student's condition about today's lesson. Then I make my plan for today's lesson.

The statement expresses that T4 did not comprehend the TB and TE approach of starting lesson with a key question.

In response to the question ‘What are the focuses of key question to start a lesson in textbooks and teacher’s edition?’, among the stakeholders The URC instructor⁴ said,

Each lesson in TB starts with a question and of course it may have a reason. It helps the teacher to conduct the class by knowing students’ condition through exploring prior knowledge.

The statement expresses that URC⁴ did not comprehend the TB and TE approach of starting lesson with a key question.

Stakeholders were asked about classroom practice of key question to start a lesson. Teacher⁴ had the reply that,

Usually, I sing lesson related rhymes or show available materials or poster from where the main thing of the lesson is mentioned, students can easily guess the lesson. For example, today I sung a birds related song so that students can guess we are going to learn animals in nature.

The statement explores that, T⁴ did not comprehend the practice of key question in science classroom.

Students’ response in FGD

Students’ of FGD were asked about the way of starting lesson. Their common response was, usually their class starts with reading text from books. One of them stated that,

Our teacher asks one of us to read the textbook and we all follow; sometimes teacher start the lesson with singing song or rhymes or some questions; we answer, if we can’t then sir reply us.

The statement of the student asserts that the teacher did not focus key question to conduct a lesson.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher’s editions (TE), it is found that there is a focus on key question to start a lesson. Key question is highlighted at the start of teaching learning activities of each lesson in TB (Figure 4.93) and TE (Figure 4.94). Therefore, this approach is extremely addressed in TB and TE.

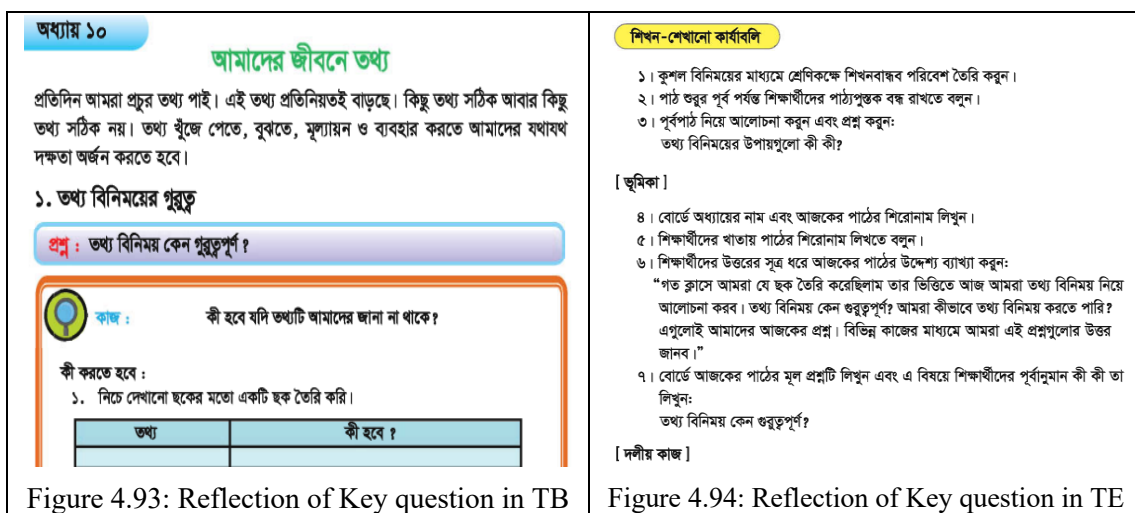


Table 4.121 summarized the findings of documents analysis, lesson observations and stakeholders’ comprehension to start a lesson.

Table 4.120: Summary of findings about starting lesson with a key question

Stakeholders	Stakeholders’ comprehension about starting lesson with a key question			Overall comprehension	No. of ILO in Grade Four	Teacher’s lesson practice	Information provided (Based on literature review)	
	Importance of key question	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Lesson-1	lessons-1: somewhat practiced	Extremely addressed	Extremely addressed
					Lesson-2	lessons-2: somewhat practiced	Extremely addressed	Extremely addressed
PTI instructor	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Lesson-3	lessons-3: somewhat practiced	Extremely addressed	Extremely addressed
URC instructor	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Lesson-4	lessons-4: somewhat practiced	Extremely addressed	Extremely addressed
AUEO	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Lesson-5	lessons-5: somewhat practiced	Extremely addressed	Extremely addressed

The findings reveal that the teacher and concerned stakeholders did not comprehend about starting lesson with a key question. The teacher did not focus key question in the science classroom. Key question extremely addressed in textbooks (TB) and in teacher’s edition (TE).

➤ Overall remark

Teacher 4’s comprehension about starting the lesson with a key was reflected in lessons practice as T4 did not focus key question in the science classroom. However, concerned stakeholders’ comprehension may also be reflected in teacher’s comprehension and

classroom practices. Though curriculum documents extremely addressed key question it was not reflected in T4 and concerned stakeholders' comprehension.

4.20.2 Exploring prior knowledge

Teacher's classroom practice

The observed lessons have been explored that, the teacher had explored students' prior knowledge for the first lesson and explored review of the lesson for the other lessons by his own way. However, that reveals students' prior knowledge exploration partial. After that the teacher started teaching learning activities. Teacher's classroom practice of prior knowledge exploration of a lesson is shown in the table 4.122, which express that the teacher has taken three lessons in one class and explored students' prior knowledge focusing only first lesson. Therefore, teacher's classroom practice has been considered as somewhat practiced regarding students' prior knowledge exploration.

Table 4.121: Teacher 4's classroom practice about exploring students' prior knowledge in Grade-4, Chapter-2

Grade & Chapter	ILO	Lesson no divided in TE	lesson title/ topic	lesson taken by the teacher	prior knowledge mentioned in TB	prior knowledge mentioned in TE	Question from previous lesson mentioned in TE	prior knowledge exploration by teacher
	2.1.1 2.1.4 2.1.7	4	Animal in nature	L-3	Where do animals live?	Where do animals live?		Ask question on animal habitat showing picture

Stakeholders' views

Stakeholders were interviewed to know their views about exploring students' prior knowledge. In response to the question 'What is the importance of exploring students' prior knowledge in the relevant topic?', PTI instructor4 said,

Exploration of students' prior knowledge is important to know their existing knowledge. The teacher first declares lesson title then tries to know students' knowledge by exploring prior knowledge. the aim is to identify their knowledge level first and then set the teaching learning activities depending on that.

In the above statement, it reveals that PTII4 has somewhat comprehension of the importance of students' prior knowledge exploration. Farther, stakeholders were asked about the scope of prior knowledge exploration in lesson in TE and TB. Among the responses, URC instructor said,

Not only in TB but also provided some opportunities at TE, teacher do not read TE or TB that way. Maximum primary teachers have training and I request them to read TE and TB in training session, but they conduct the classes as usual through book reading.

In the statement it reveals that URC4 has somewhat comprehension about the given information at TE and TB.

In addition, stakeholders were further asked about the classroom practice of students' prior knowledge exploration. The teacher4 said,

I try to explore students' prior knowledge through oral questions or showing teaching aid. When I start the lesson-difference between plants and animals, I called a student and brought a plant tub as teaching aid and asked them related question.

The statement reveals URC4's somewhat comprehension of classroom practice of exploring prior knowledge.

Students' response in FGD

Students were asked about classroom practice of prior knowledge exploration. One of them had the reply that,

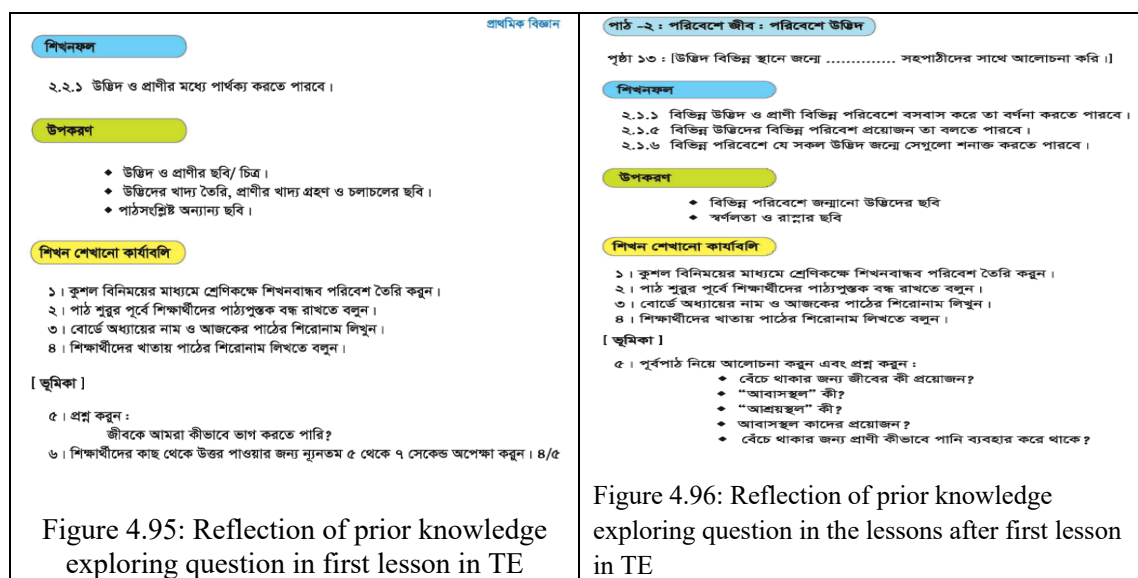
Usually, our class starts with reading the book. Sometimes, teacher asked us questions on today's lesson or sometimes from the previous lesson.

The statement reveals somewhat classroom practices of prior knowledge exploration.

Information provided in TB and TE

Analyzing the observed lessons, conducted by T4 from primary science textbooks it is found that, a very short introduction is placed at the start of each teaching-learning activity. Usually, teachers use it for prior knowledge exploration, which was also found in lesson observations and interviews. Analyzing the observed lessons in TE it is found that, TE addressed prior knowledge exploring questions for the first lesson of a chapter (Figure

4.97), and addressed questions of review of the previous lesson for the rest lessons (Figure 4.98). Although the lessons in a chapter are interrelated and all lessons contain some new additions; therefore, exploring students' prior knowledge is needed besides reviewing the previous lesson in each lesson. Consequently, the Information provided for prior knowledge exploration in TE has been considered as somewhat addressed.



A summary of the findings of documents analysis, lesson observations and stakeholders' comprehension regarding prior knowledge exploration is presented in the table next.

Table 4.122: Summary of findings about exploring students' prior knowledge

Stakeholders	Stakeholders' comprehension about exploring students' prior knowledge			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of exploring students' prior knowledge	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-1	lessons-1: somewhat practiced	Somewhat addressed	Somewhat addressed
					Lesson-2	lessons-2: somewhat practiced	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3	lessons-3: somewhat practiced	Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-4	lessons-4: somewhat practiced	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-5	lessons-5: somewhat practiced	Somewhat addressed	Somewhat addressed

The findings of the table 4.123 reveals that the teacher has somewhat comprehension, and concerned stakeholders have somewhat comprehension about exploring students' prior knowledge. However, the teacher somewhat explored students' prior knowledge in the science classroom. Moreover, the information of exploring students' prior knowledge is somewhat addressed in textbooks (TB) and in teacher's edition (TE).

➤ **Overall remark**

Teacher4's somewhat comprehension about exploring students' prior knowledge was reflected in T4's lessons practice as T4 somewhat explore students' prior knowledge in the science classroom. However, concerned stakeholders' somewhat comprehension may also be reflected in teacher's comprehension and classroom practices. Moreover, the somewhat addressed information in curriculum documents may also be reflected in T4 and concerned stakeholders' comprehension.

4.20.3 Real-life orientation of science concept

Teacher's classroom practice

It has been observed in lesson observations that the teacher tried to orient the science concepts with some real-life examples and with a very small amount of real material in own way. However, the number of supplied teaching aid was not sufficient for teaching learning activities in all the observed classes of T4, which is indicated as somewhat practice in Table 4.125. Out of four observed lessons of T4, one is shown in table 4.124 as teacher's classroom activity.

Table 4.123: Teacher 4's classroom practice about real-life orientation of science concept in Grede-4, Chapter-2

Grade & Chapter	ILO	Lesson no divided in TE	Lesson title	Lesson taken by the teacher	Real life orientation activities and example mentioned in TB	Real life orientation activities and example mentioned in TE	Activities done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	L-1	-Provided some picture of plants and animals	Mentioned some picture of plants and animals	-Show a student, a plant and the picture By TB in a enlarge form

Stakeholders' views

To know about the necessity of linking real-life situation with science concepts, stakeholders were asked question. AUEO 4 said,

It is essential to relate the scientific concepts with real-life situations. Otherwise, effective learning can't be achieved and learning outcomes can't sustain. It also helps the teacher to conduct the lesson easily. For example, as there are many sources (tube well, tape, pond etc.) and types of water (pure and polluted), the teacher easily engages them to choose their drinking water. After their response, it is easy to conduct the class and achieved the learning outcome.

The statement reveals AUEO4's moderate comprehension of real-life orientation with science concepts.

In response to the asked question of the scope of linking real-life situation with science concepts in lesson in TE and TB, teacher 4 said,

The content in TB is related to real life. In TB habitat of plant and animals are mentioned through picture, students can easily find them around and understand.

The statement explores T4's moderate comprehension of the given information in curriculum documents.

To know stakeholders' view, they were asked to respond about the classroom practice of linking real-life situation with science concepts. Among the stakeholders, PTI instructor4 said,

I only see the trainee teachers' classes, teacher try to connect the content with students' real life following TB and TE, they use many teaching aids to understand the students.

The statement explores PTII4's moderate comprehension of the classroom practice of real life orientation with science concepts.

Students' response in FGD

In response to the asked question about the classroom practice of orienting science concepts with real life, one of them replied that,

Teacher gives us example with our daily life and sometimes carry sample materials in class. However, the sample materials are too limited that we can't follow the sample materials.

The statement of the student expresses that teacher4 somewhat focuses on the orientation of science concepts with real life that way.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, the topics and examples of all the chapters are more or less related to our daily life; such as Our environment, materials, food, energy, natural resources, technology, first aid etc. (NCTB, 2020). Both TB and TE provided some real-life examples connecting with science concepts.

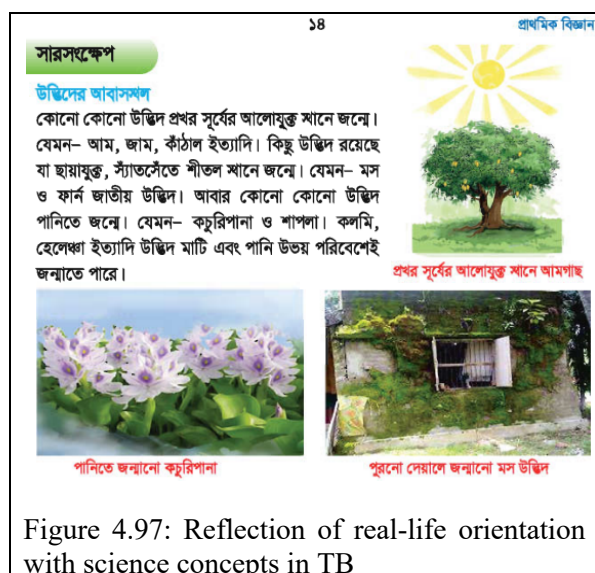


Figure 4.97: Reflection of real-life orientation with science concepts in TB

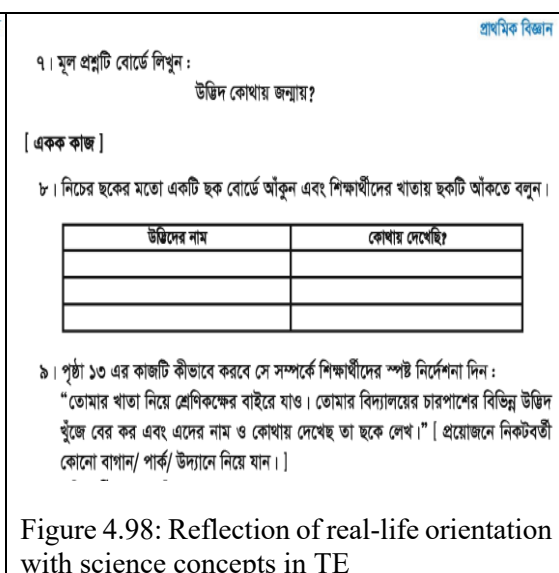


Figure 4.98: Reflection of real-life orientation with science concepts in TE

The finding of documents analysis, lesson observations and stakeholders' comprehension regarding orientation of science concepts with real life are summarized in the next table.

Table 4.124: Summary of findings about real-life orientation of science concept

Stakeholders	Stakeholders' comprehension about exploring students' prior knowledge			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of exploring students' prior knowledge	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Lesson-1	lessons-1: somewhat practiced	Moderately addressed	Somewhat addressed
					Lesson-2	lessons-2: somewhat practiced	Moderately addressed	Somewhat addressed
PTI instructor	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Lesson-3		Moderately addressed	Somewhat addressed

Stakeholders	Stakeholders' comprehension about exploring students' prior knowledge			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of exploring students' prior knowledge	Given information in TE & TB	Way of practice in classroom				In TB	In TE
URC instructor	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Lesson-4	lessons-3: somewhat practiced	Moderately addressed	Somewhat addressed
AUEO	Moderately comprehend	Moderately comprehend	Moderately comprehend	Moderately comprehend	Lesson-5	lessons-4: somewhat practiced	Moderately addressed	Somewhat addressed

The findings of the table reveal that teacher 4 and concerned stakeholders mostly have moderate comprehension of orientation of science concept with real life. T4 somewhat orient science concept with real life. The information about orientation of science concept with real life, is moderately addressed both in textbooks (TB) and in somewhat addressed in teacher's edition (TE).

➤ Overall remarks

Teacher 1's moderate comprehension of the orientation of science concept with real life is somewhat reflected in the science classroom. However, concerned stakeholders' moderate comprehension may also be reflected in T4's comprehension and classroom practices. Moreover, the moderate to somewhat addressed information in curriculum documents may also be reflected in T4 and concerned stakeholders' moderate comprehension.

4.20.4 Science process skills

Teacher's classroom practice

It has been explored from the observed lessons that, T4 practiced somewhat. Teacher's classroom practice focusing science process skill of a lesson is shown in the table 4.126, where T4 slightly focus on observation.

Table 4.125: Teacher 4's classroom practice about science process skills in Grade-4, Chapter-2

Grade & Chapter	ILO	Lesson no divided in TE	lesson topic	lesson taken by the teacher	science process skills mentioned in TB	science process skills mentioned in TE	Activities done by the teacher
Grade-4 Chapter-2	2.1.1 2.1.5 2.1.6	2	Plants in nature	L-2	Observation Decision making	Observation Decision making	Observation

Grade & Chapter	ILO	Lesson no divided in TE	lesson topic	lesson taken by the teacher	science process skills mentioned in TB	science process skills mentioned in TE	Activities done by the teacher
"Plants and Animals"	2.1.1 2.1.5 2.1.6	3	Plants in nature			Observation Decision making	

Stakeholders' views

Stakeholders were asked 'What are the opportunities of students for achieving science process skills through science learning?'. AUEO4 said,

It is very important; it helps to develop students' various types of skills for their life. For example, select the essential things needed for your daily use, separate the things related to food from the supplied materials, teacher can help to develop students' skills.

The statement reveals AUEO4's somewhat comprehension of science process skills.

In response to the question about the information provided in TE and TB about the opportunities of students for achieving science process skills through science learning, Teacher4 said,

Not seen TE that way, TB provided pictures of related content in all most all the content so that students can observe and understand, I try to focus on that. For example, in lesson "plants in nature" TB provided pictures of plants in different habitats, students observe it.

The statement reveals that T4 did not comprehend the provided information in curriculum documents about science process skills.

On the basis of asked question about the classroom practice of achieving science process skills through science learning, PTI instructor4 said,

Teacher tries to engage students with scientific activity at classroom, so they can develop the skill of measure, count, observe etc.

Th statement reveals that PTII4 has somewhat comprehension about classroom practice of science process skills.

Students' response in FGD

In response to the asked question about the classroom practice of achieving science process

skills through science learning, one student of FGD asserted,

Usually, we do not do any activity in science classes. Our teacher read the text by him/herself or sometimes we do it. Then write the Q-A.

From the statement it exposes that, T4 did not focus on science process skills in science classroom.

Information provided in TB and TE

Analyzing the primary science text books and teacher's edition it is found that, there are some activities in each lesson focusing on science process skills like; demonstration, observation, experiment, investigation, decision making (NCTB, 2020). Figure 4.99, reflects the science process skill of a lesson in TB. Here, observation skill is mentioned for identifying different types of soil. Figure 4.100, reflects science process skills in TE where also observation skills are mentioned.

উদ্ভিদ ও প্রাণী ১৩

২. পরিবেশে জীব

(১) পরিবেশে উদ্ভিদ

উদ্ভিদ বিভিন্ন স্থানে জন্মে। কিছু উদ্ভিদ মাটিতে কিছু উদ্ভিদ পানিতে জন্মে। আবার কিছু উদ্ভিদ মাটি ও পানি উভয় পরিবেশেই জন্মে।

প্রশ্ন : উদ্ভিদ কোথায় কোথায় জন্মে?

কাজ : উদ্ভিদ কোথায় জন্মে?

কী করতে হবে :

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

উদ্ভিদের নাম	কোথায় দেখেছি

২. খাতা নিয়ে শ্রেণিকক্ষের বাইরে যাই।

৩. বিদ্যালয়ের চারপাশে বিভিন্ন উদ্ভিদ খুঁজে বের করি এবং ছকটিতে উদ্ভিদের নাম এবং সেটি কোথায় দেখেছি তা লিখি।

৪. কাজটি নিয়ে সহপাঠীদের সাথে আলোচনা করি।

Figure 4.99: Reflection of science process skills in TB

উদ্ভিদ ও প্রাণী

[একক কাজ]

১০। নিচের ছকের মতো একটি ছক বোর্ডে আঁকুন এবং শিক্ষার্থীদের খাতায় ছকটি আঁকতে বলুন।

প্রশ্ন	উদ্ভিদ	প্রাণী
কীভাবে শক্তি পায়?		
কী কী অঙ্গ বা অংশ রয়েছে?		
কীভাবে চলাচল করে?		
কীভাবে সন্তান প্রদান করে?		
আরও কিছু?		

১১। পৃষ্ঠা ১১ এর কাজটি কীভাবে করবে সে সম্পর্কে শিক্ষার্থীদের স্পষ্ট নির্দেশনা দিন :
“ছকের প্রশ্নের আলোকে উদ্ভিদ ও প্রাণীর বৈশিষ্ট্যের তালিকা তৈরি কর।”

১২। শিক্ষার্থীদের কাজটি করতে বলুন।

১৩। শ্রেণিকক্ষ ঘুরে শিক্ষার্থীদের কার্যক্রম পর্যবেক্ষণ করুন এবং প্রয়োজনীয় সহায়তা দিন।

☐ মূল্যায়ন : শিক্ষার্থীরা নিজে নিজে কাজটি সম্পন্ন করছে কিনা যাচাই করুন।

- ➔ দৃষ্টিভঙ্গি : স্বতঃস্ফূর্ততা, সক্রিয়তা, কৌতূহল
- ➔ প্রক্রিয়াকরণ দক্ষতা : পর্যবেক্ষণ, সিদ্ধান্ত গ্রহণ

Figure 4.100: Reflection of science process skills in TE

The findings of science process skills from documents analysis (TB & TE), lessons observation, and stakeholders' comprehension are summarized in the next table.

Table 4.126: Summary of findings about science process skills.

Stakeholders	Stakeholders' comprehension of science process skills			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of science process skills	Given the information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Lesson-1	lessons-1: somewhat practiced	Somewhat addressed	Somewhat addressed

Stakeholders	Stakeholders' comprehension of science process skills			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of science process skills	Given the information in TE & TB	Way of practice in classroom				In TB	In TE
					Lesson-2	lessons-2: somewhat practiced	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3		Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-4	lessons-3: somewhat practiced	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-5	lessons-4: somewhat practiced	Somewhat addressed	Somewhat addressed

The findings of the table reveal that concerned stakeholders have moderate to somewhat comprehension of science process skills. T4 did not comprehend science process skills; but somewhat focused on science process skills in the science classroom. Science process skills were moderately addressed and sometimes did not address, in the observed lessons of TB and TE.

➤ Overall remarks

Though T4's did not comprehend science process skills it did not reflect in T4's science classroom practice. However, concerned stakeholders' mostly somewhat comprehension did not reflect in T4's comprehension. Moreover, the somewhat addressed information on science process skills in curriculum documents may also be somewhat reflected in concerned stakeholders' comprehension.

4.20.5 Activity-based class

Teacher's classroom practice

It has been explored from the observed lessons that, T4 did not do any activity in the science classroom. The next table presents T4's classroom activity about activity-based class.

Table 4.127: Teacher 4's classroom practice of activity-based class in Grade-4, Chapter-2

Grade & Chapter	ILO	Lesson divided in TE	lesson topic	lesson taken by the teacher	activity mentioned in TB	activity mentioned in TE	Activity done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	L-1	-fill-up the table -Group discussion	-fill-up the table	-fill-up the table

Stakeholders' views

Stakeholders were asked about the importance of activity-based class for science teaching-learning. In response, PTII4 said,

Teacher engages students in different activities like role play and others within the class, so that they can learn by their own.

The statement reveals PTII4's somewhat comprehension of the importance of activity-based classes.

In response to the question about the Information provided of opportunity for activity-based class in TE and TB, URC instructor4 said,

TB and TE mentioned group work for students active learning. Group work mentioned at almost all the chapter of TB and TE. Through group work students can discuss and give their opinion about the lesson.

The statement reveals URCI4's somewhat comprehension of the provided information in curriculum documents.

Stakeholders were asked about the classroom practice of activity-based classes. Teacher 4 stated that,

I form group with students and instruct them to fill up the provided table with group discussion.

In the statement, T4 explains activity-based learning as group work with group discussion. However, this statement reveals that T4 did not comprehend activity-based class.

Students' response in FGD

Students of FGD were asked about the classroom practice of activity-based learning. One of them had the reply that,

Usually, we do not get the chance to do any activity in science classes. Sometimes teacher did it only in front of the class by own self.

The statement also explores T4's classroom practice that T4 did not practice activity in the science classroom.

Information provided in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that there are activities in each lesson (Figures 4.101 and 4.102).

উদ্ভিদ ও প্রাণী ১৫

(২) পরিবেশে প্রাণী

প্রাণী বিভিন্ন স্থানে বাস করে। যেমন- মাটি, পানি, গাছপালা, পাহাড়-পর্বত ইত্যাদি। কোন প্রাণী কোন স্থানে বাস করে?

প্রশ্ন : প্রাণী কোথায় কোথায় বাস করে?

কাজ : প্রাণীর বাসস্থান

কী করতে হবে :

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

প্রাণীর নাম	কোথায় বাস করে

২. নিচের ছবিটি দেখে বিভিন্ন প্রাণী ও তাদের বাসস্থান উপরের ছকে লিখি।

৩. কাজটি নিয়ে সহপাঠীদের সাথে আলোচনা করি।

Figure 4.101: Reflection of activity-based content in TB

উদ্ভিদ ও প্রাণী [একক কাজ]

১০। নিচের ছকের মতো একটি ছক বোর্ডে আঁকুন এবং শিক্ষার্থীদের খাতায় ছকটি আঁকতে বলুন।

প্রশ্ন	উদ্ভিদ	প্রাণী
কীভাবে শক্তি পায়?		
কী কী অঙ্গ বা অংশ রয়েছে?		
কীভাবে চলচল করে?		
কীভাবে সন্তান প্রদান করে?		
আরও কিছু?		

১১। পৃষ্ঠা ১১ এর কাজটি কীভাবে করবে সে সম্পর্কে শিক্ষার্থীদের স্পষ্ট নির্দেশনা দিন :
“ছকের প্রশ্নের আলোকে উদ্ভিদ ও প্রাণীর বৈশিষ্ট্যের তালিকা তৈরি কর।”

১২। শিক্ষার্থীদের কাজটি করতে বলুন।

১৩। প্রেক্ষিক যুগে শিক্ষার্থীদের কার্যক্রম পর্যবেক্ষণ করুন এবং প্রয়োজনীয় সহায়তা দিন।

☐ মূল্যায়ন : শিক্ষার্থীরা নিজে নিজে কাজটি সম্পন্ন করেছে কিনা যাচাই করুন।
☐ দৃষ্টিভঙ্গি : স্বতন্ত্রতা, সক্রিয়তা, কৌতূহল
☐ প্রক্রিয়াকরণ দক্ষতা : পর্যবেক্ষণ, সিদ্ধান্ত গ্রহণ

[দলীয় কাজ]

১৪। শিক্ষার্থীদের নিজেদের ধারণাগুলো দলের সবার সাথে আলোচনা করতে বলুন।

১৫। প্রেক্ষিক যুগে শিক্ষার্থীদের কাজ পর্যবেক্ষণ করুন এবং প্রয়োজনীয় দলীয় আলোচনায় শিক্ষার্থীদের সহায়তা দিন।

Figure 4.102: Reflection of activity-based content in TE

A summery finding of activity-based class from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the table 4.129.

Table 4.128: Summary of findings about activity-based class

Stakeholders	Stakeholders' comprehension about activity-based class			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of activity in science class	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Did not comprehend	Did not comprehend	Did not comprehend	Did not comprehend	Lesson-1	lessons-1: did not practiced	Moderately addressed	Moderately addressed
					Lesson-2	lessons-2: did not practiced	Moderately addressed	Moderately addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3	lessons-3: did not practiced	Moderately addressed	Moderately addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-4	lessons-4: did not practiced	Moderately addressed	Moderately addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-5	lessons-5: did not practiced	Moderately addressed	Moderately addressed

The findings of the table reveal that T4 did not comprehend and concerned stakeholders have somewhat comprehension about activity-based classes. T4 did not focus on activity

in the science classroom. Moderate information has been provided in TB and TE for activity- based classes.

➤ **Overall remarks**

Teacher 4's comprehension of activity-based science class was reflected in T4's classroom practice. Concerned stakeholders' somewhat comprehension may also be reflected in T4's comprehension and classroom practices. Moreover, though curriculum documents moderately addressed the information, it did not reflect on T4 and concerned stakeholders' comprehension.

4.20.6 Collaborative approach

Teacher's classroom practice

Out of four lessons, the teacher did not seat the students into groups for group activity or group discussion. Therefore, the students did not get the chance to cooperate each other with activity or sharing their idea about the lessons. Teacher's focus was only on reading the text. Teacher's classroom activity of a lesson is shown in the table next.

Table 4.129: Teacher 4's classroom practice of collaborative approach Grade-4, Chapter-2

Grade & Chapter	ILO	Lesson no divided in TE	Lesson topic	Lesson taken by the teacher	Collaborative approach mentioned in TB	Collaborative approach mentioned in TE	Activities done by the teacher
Grade-4 Chapter-2	2.1.1 2.1.5 2.1.6	2	Plants in nature	Lesson-2	Group discussion after fil-up the table	-	Fill-up the table
	2.1.1 2.1.5 2.1.6	3	Plants in nature			Group discussion after fil-up the table	

Stakeholders' views

Stakeholders were asked for their opinion about collaborative approach in science teaching-learning. Teacher 4 said,

Collaborative approach is group discussion where students learn by sharing their idea. Usually, I instruct the students to form group and discuss the content within group.

The statement expresses T4's somewhat comprehension of collaborative approach.

Stakeholders were asked about the opportunity of collaborative approach mentioned in TE and TB. Among the stakeholders, URC instructor4 said,

‘Almost all the lessons of TE and TB mentioned group discussion’.

The statement expresses URCI4's somewhat comprehension of the collaborative approach.

Stakeholders were asked about the practice of collaborative approach in classroom. PTI instructor4 said,

Almost all the primary teacher has PTI training, collaborative approach of learning is mentioned in DPED program. Teacher tried their best to follow the instruction. For example, I found the teacher doing role play with the students and then engaging them in group work.

The statement expresses PTI4's somewhat comprehension about the classroom practice of collaborative approach.

Students' response in FGD

Students of FGD were asked about the classroom practice of collaborative approach.

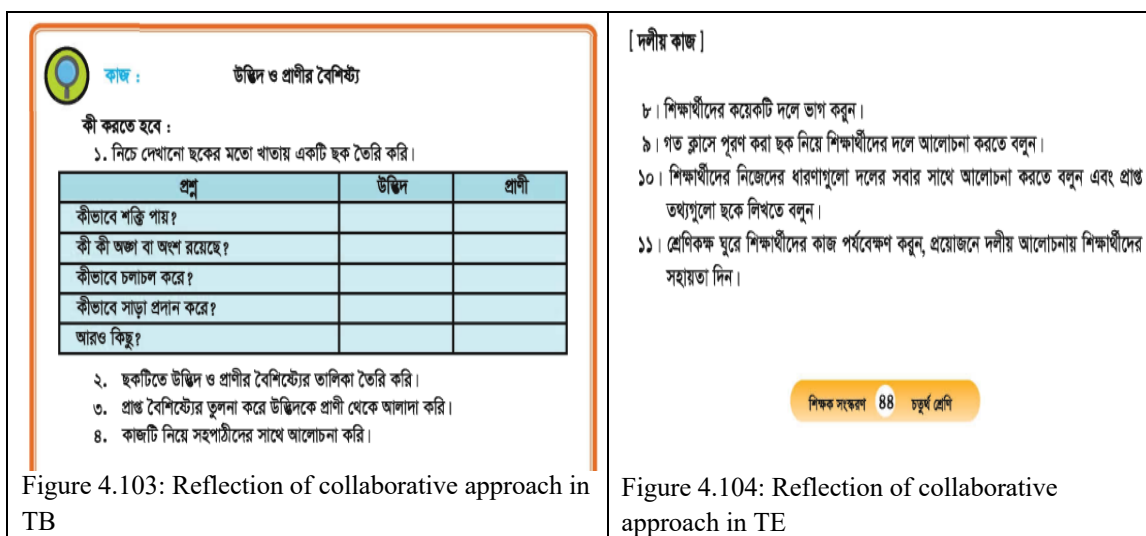
One of them replied,

Usually, they do not get the chance to do any activity in science classes. Sometimes they seated in groups and fill up the given chart and table following textbooks, but it's very rare for them, maximum time they do it is following teacher's instruction on the board.

The statement of the students reveals that, actually the classroom practice of collaborative approach is absent.

Provided information in TB and TE

Analyzing the primary science textbooks and teacher's edition of observed lessons, it is found that there is mention of discussion with classmates in TB (Figure 4.103) and instructed group activities with group discussion in TE (Figure 4.104).



The findings of collaborative approach from documents analysis (TB & TE), lesson observations and stakeholders’ comprehension are presented in the next table.

Table 4.130: Summary of findings about collaborative approach

Stakeholders	Stakeholders’ comprehension about activity-based class			Overall comprehension	No. of ILO in Grade Four	Teacher’s lesson practice	Information provided (Based on literature review)	
	Importance of activity in science class	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-1	lessons-1: did not practice	Somewhat addressed	Moderately addressed
					Lesson-2	lessons-2: did not practice	Somewhat addressed	Moderately addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3	lessons-3: did not practice	Somewhat addressed	Moderately addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-4	lessons-4: did not practice	Somewhat addressed	Moderately addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-5	lessons-5: did not practice	Somewhat addressed	Moderately addressed

The findings of the table reveal that T4 and concerned stakeholders have somewhat comprehension about the collaborative approach. T4 did not focus collaborative approach in the science classroom. The information on the collaborative approach has been somewhat addressed in TB, and moderately addressed in TE.

➤ Overall remarks

Teacher1's somewhat comprehension of the collaborative approach was reflected in T4's classroom practice. However, concerned stakeholders' somewhat comprehension may also be reflected in T4's comprehension and classroom practices. The somewhat to moderately addressed information of the collaborative approach in curriculum documents may also be reflected in T1 and concerned stakeholders' comprehension.

4.20.7 Illustrations (Pictures and Photographs)

Teacher's classroom practice

There are content-related photographs and illustrations for activities and examples in TB. The teacher did not focus on any illustrations or photographs provided in TB and TE that way. The teacher gave only some examples of his own in two classes; that is mentioned as somewhat practice in the table. One of the teacher's classroom practices is presented in the table next.

Table 4.131: Teacher 4's classroom practice about illustrations in Grade-4, Chapter-2

Grade & Chapter	ILO	Lesson divided in TE	lesson topic	The lesson was taken by the teacher	Illustrations and diagrams mentioned in TB	Illustrations and diagrams mentioned in TE	Activities are done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	Lesson-1	Illustration of plant and animal	-	Show TB provided illustration in enlarged form

Stakeholders' views

Stakeholders were asked about the importance of illustrations to achieve the content knowledge. PTI instructor4 said,

Basically, illustrations and diagrams are related to content and it helps students to gain content knowledge. For example, in chapter 'Soil' if the teacher can't manage three types of soil, then illustrations and diagrams related to soil content help the students to gain concepts of different types of soil.

The statement reveals PTII4's somewhat comprehension of the importance of illustrations.

In addition, stakeholders were asked about the consistency of the text and Illustrations mentioned in TE and TB. T4 alluded,

Illustrations and diagrams of the TB are very important and help me to conduct science classes. I conduct the classes with my own plan and get help from the TB, but did not think of the consistency of the text and the illustration and diagram that way.

The statement reveals T4's somewhat comprehension of the provided illustration in curriculum documents.

Participants were asked about the practice of illustration and diagrams in the classroom. URC instructor 4 said

Teachers use illustrations and diagrams from textbooks but government provides separate materials for them, even provided illustrations of TB are supplied in clear and enlarged form, but teacher does not carry them in the class that way.

The statement reveals URCI4's somewhat comprehension of the use of illustration in curriculum documents.

Students' response in FGD

Students of FGD were asked about the classroom practice of illustrations and diagrams. One of them replied,

Usually, our classes conduct with reading text from textbooks, and then we notice the picture from textbooks.

The statement of the student is reveals that the teacher does not focus on illustration and photographs in the science classroom.

Provided information in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, the topics and examples of all the chapters are more or less related to our daily life. Moreover, it is found from the observed lessons that there are content related photographs and illustrations for activities and examples in TB. Therefore, science concept related

photographs are available, which helps students to understand science concept linking with real-life. However, in some cases illustrations are provided rather than photographs. it might be more relevant to the content if photographs are provided.

The findings of the collaborative approach from documents analysis (TB & TE), lesson observations, and stakeholders' comprehension are presented the table 4.133.

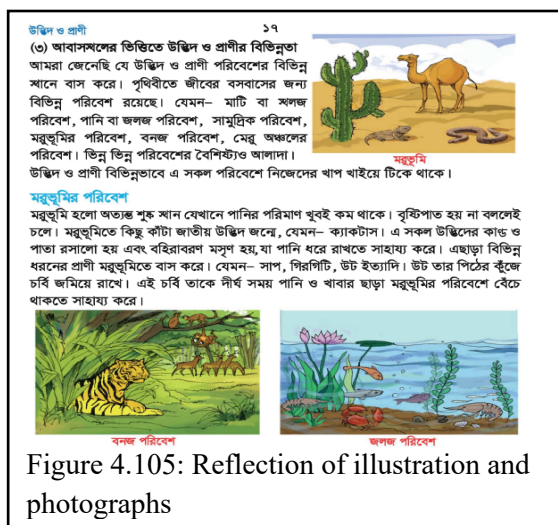


Figure 4.105: Reflection of illustration and photographs

Table 4.132: Summary of findings about illustrations

Stakeholders	Stakeholders' comprehension about illustrations			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of illustrations	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-1	lessons-1: somewhat practiced	Moderately addressed	Did not addressed
					Lesson-2	lessons-2: somewhat practiced	Moderately addressed	Did not addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3	lessons-3: somewhat practiced	Moderately addressed	Did not addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-4	lessons-4: somewhat practiced	Moderately addressed	Did not addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-5	lessons-5: somewhat practiced	Moderately addressed	Did not addressed

The findings of the table reveal that T4 and concerned stakeholders have somewhat comprehension of content-related illustrations. T4 somewhat focused illustrations in the science classroom. Related illustrations are moderately addressed in TB, and did not provide in TE.

➤ Overall remarks

Teacher 4's somewhat comprehension of the approaches of illustrations was reflected in T41's classroom practice. However, concerned stakeholders' somewhat comprehension may also be reflected in the T4's comprehension and classroom practices. Though the illustrations are moderately addressed in the curriculum document; may not be reflected in

T4 and concerned stakeholders' comprehension accordingly.

4.20.8 Scope of scientific inquiry

Teacher's classroom practice

Four lessons of T4 have been observed. The findings of one observed lesson are presented in the table. 4.134, where it is explored that, T4 did not engage the students with scientific inquiry. The students did not get the chance to do the activity; collect data and finally formulate, evaluate or justify the explanation that way.

Table 4.133: Teacher 4's classroom practice regarding illustrations in Grade-4, Chapter-2

ILO	Lesson in TE	Lesson title	No. of lesson taken by the teacher	Information given in TB	Information given in TE	Teacher's classroom practice
4.1.1	2 & 3	different types of soil	Lesson-1	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify explanation	*Formulate the problem *Collecting data *Formulate explanation *Evaluate explanation *Justify the explanation	*did not formulate problem *did not engage students any activity

Stakeholders' views

Stakeholders were asked for their opinion about inquiry-based teaching. AUEO4 said,

Inquiry-based learning is the learning where students learn by themselves. They do the activity on their own, but it is not for the elementary, level students, they cannot do the activities on their own.

The statement expresses that AUEO4 did not comprehend inquiry-based teaching.

Stakeholders were asked about the opportunity for inquiry-based teaching mentioned in TE and TB. PTI instructor4 said,

Science books have been prepared focusing inquiry. Many activities have been included in each lesson for students better understanding. They can acquire knowledge through learning by doing process

The statement expresses that PTII4 somewhat comprehend the information given in curriculum documents about inquiry-based teaching.

Participants were asked about the practice of inquiry in science classroom. URC instructor said,

Our teacher conducts their science classes through traditional lecture method. They do not engage the students with activities.

The statement expresses that URICI4 did not comprehend the classroom practice of inquiry-based teaching.

Students' response in FGD

Students' of FGD were asked about their way of learning through inquiry. One of them stated that,

Actually, we could not get the chance to do any activity in the science classroom. Maximum time our class conducts through text reading from the textbook and teacher asks us question to evaluate

The statement of the student, reveals that the teacher did not focus inquiry-based teaching to conduct a lesson.

Information Provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on inquiry-based teaching. Figure 4.106 presents the reflection of inquiry in TB. This lesson of TB presents a process of inquiry-based teaching: engaging with a scientific question, collect data, formulate explanation, evaluate explanation and justify explanation.

উদ্ভিদ ও প্রাণী ১৫

(২) পরিবেশে প্রাণী

প্রাণী বিভিন্ন স্থানে বাস করে। যেমন- মাটি, পানি, গাছপালা, পাহাড়-পর্বত ইত্যাদি। কোন প্রাণী কোন স্থানে বাস করে?

প্রশ্ন : প্রাণী কোথায় কোথায় বাস করে?

কাজ : প্রাণীর বাসস্থান

কী করতে হবে :

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

প্রাণীর নাম	কোথায় বাস করে

২. নিচের ছবিটি দেখে বিভিন্ন প্রাণী ও তাদের বাসস্থান উপরের ছকে লিখি।
৩. কাজটি নিয়ে সহপাঠীদের সাথে আলোচনা করি।



১৬ প্রাথমিক বিজ্ঞান

সামুদ্রিক পরিবেশ

সমুদ্র হলো লবণাক্ত পানির বিশাল ভান্ডার। সমুদ্র অনেক ধরনের উদ্ভিদ ও প্রাণীর আবাসস্থল। সামুদ্রিক প্রাণীর মধ্যে রয়েছে ভিমি, ডলফিন, মাছ, কীকড়া ইত্যাদি। সামুদ্রিক উদ্ভিদের মধ্যে রয়েছে বিভিন্ন ধরনের সামুদ্রিক শৈবাল।

মেঘু অঞ্চলের পরিবেশ

পৃথিবীর উত্তর ও দক্ষিণের সবচেয়ে ঠাণ্ডা ও বরফ আচ্ছাদিত স্থানই মেঘু অঞ্চল। মেঘু অঞ্চলে কিছু ঘাস ও পাইন জাতীয় উদ্ভিদ দেখা যায়। এছাড়া মেঘু ভালুক, সিল, পেঙ্গুইন ইত্যাদি প্রাণী মেঘু অঞ্চলে বাস করে। ঠাণ্ডা থেকে বাঁচার জন্য এ সকল প্রাণীর চামড়া অত্যন্ত পুরু হয় এবং পশমে ঢাকা থাকে।

আলোচনা

কোন কোন পরিবেশে জীব বাস করে?

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

বাসস্থান	উদ্ভিদ	প্রাণী
মহুত্মির পরিবেশ		
বনজ পরিবেশ		
জলজ পরিবেশ		
সামুদ্রিক পরিবেশ		
মেঘু অঞ্চলের পরিবেশ		

২. ছকে উপস্থাপিত আবাসস্থলগুলোতে থাকে এমন উদ্ভিদ ও প্রাণীর তালিকা তৈরি করি।
৩. সহপাঠীদের সাথে আলোচনা করে কাজটি সম্পন্ন করি।




মেঘু ভালুকের পুরু পশম রয়েছে

Figure 4.106: Reflection of inquiry-based learning in TB

The finding of documents analysis, lesson observations and stakeholders' comprehension regarding inquiry-based teaching are summarized in next table.

Table 4.134: Summary of findings about inquiry-based teaching

Stakeholders	Stakeholders' comprehension about inquiry based teaching			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of inquiry based teaching	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-1	lessons-1: somewhat practiced	Moderately addressed	Moderately addressed
					Lesson-2	lessons-2: somewhat practiced	Moderately addressed	Moderately addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3	lessons-3: somewhat practiced	Moderately addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-4	lessons-4: somewhat practiced	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-5	lessons-5: somewhat practiced	Moderately addressed	Moderately addressed

The findings of the table reveal that T4 and concerned stakeholders mostly did not comprehend inquiry-based teaching. T4 did not practice inquiry in the science classroom. The inquiry-based teaching approach is moderately addressed in TB and TE.

➤ Overall remarks

Teacher4's comprehension of inquiry-based teaching was reflected in T4's classroom practice as T4 did not practice it. Concerned stakeholder mostly did not comprehend; that may be reflected in T4's comprehension and classroom practices. Though curriculum documents moderately provided the information of inquiry teaching, it may not be reflected in T4 and concerned stakeholders' comprehension.

4.20.9 Lesson summary

Teacher's classroom practice

The teacher randomly instructed a few students to read the text after teaching-learning activities in all the observed classes; that was mentioned as somewhat practiced in the table. One of teacher's classroom practice is presented in the table next.

Table 4.135: Teacher 4's classroom practice about lesson summary in Grade-4, Chapter-2

Grade & Chapter	ILO	Lesson divided at TE	lesson topic	lesson was taken by the teacher	Lesson summary mentioned in TB	Lesson summary mentioned in TE	Activities done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	Lesson-1	content related text	As a part of teaching learning activities	a few students read the summary

Stakeholders' views

Stakeholders were asked for their opinion about the importance of the lesson summary.

AUEO 4 said,

Lesson summary is good for teachers. It gives an indication of what the gist is after 35 minutes of class. The teacher will be able to justify that there are 50 students in my class for so long that we have done the teaching learning all through different processes. What did you actually learn? the main theme will be if 2-4 children can say. The teacher expects the lesson title, if it matches, then the teacher will understand that the class is fruitful, so a lesson summary is needed, it facilitates learning. TB provided it at the end of each lesson but did not notice TE that way'.

The statement reveals AUEO4's somewhat comprehension of the importance of the lesson summary.

Moreover, stakeholders were asked for their opinion about information provided in TE and TB. PTI Instructor4 said,

Lesson summary is the end part of the total lesson where the whole lesson is expressed shortly. When learning outcomes are achieved by the students through teaching learning, then the teacher summaries the whole lesson shortly and starts assessment part. So, lesson summary is very important for students learning. I found it in TB but did not notice it in TE that way.

The statement reveals PTII4's somewhat comprehension of the provided information in TB and TE of lesson summary.

Stakeholders were asked about the practice of lesson summary in classroom. URC instructor4 said,

The provided information of lesson summery at TE have details on students' assessment and closing of the lesson but our teacher does not even see it. They always try to read out the text by several students again and again.

The statement reveals URCI4's somewhat comprehension of the classroom practice about of lesson summary.

Students' response in FGD

Students of FGD were asked about the classroom practice of lesson summary. One of them replied,

Usually, teacher instruct us to read this text again and again to memorize lessons, we do it in groups or individual.

The statement of the student is reveals that the teacher wants the students to memorize by reading the text over and over again.

Provided information in TB and TE

Analyzing the existing primary science textbooks and teacher's edition it is found that, summery is placed as content text in TB, whereas TE highlighted it as the end part of TLA which may create confusion of the stakeholders.

সারসংক্ষেপ ১২ প্রাথমিক বিজ্ঞান

উদ্ভিদ এবং প্রাণী নানাবাবে একে অপর থেকে ভিন্ন।

খাদ্য তৈরি

উদ্ভিদ নিজের খাদ্য নিজেই তৈরি করে। প্রাণী নিজের খাদ্য নিজে তৈরি করতে পারে না। খাদ্যের জন্য প্রাণী বিভিন্ন উদ্ভিদ এবং অন্যান্য প্রাণীর উপর নির্ভরশীল।



উদ্ভিদ নিজের খাদ্য নিজে তৈরি করে প্রাণী খাদ্যের জন্য অন্যের উপর নির্ভর করে

দেহের বিভিন্ন অংশ বা অংশ

উদ্ভিদের দেহে বিভিন্ন অংশ যেমন- মূল, কাণ্ড এবং পাতা রয়েছে। একইভাবে প্রাণীর হাত, পা, ডানা বা পাখনা রয়েছে। কিছু প্রাণীর দেহে পশম বা লোম রয়েছে। আবার কিছু প্রাণীর দেহে রয়েছে আইশ বা পালক। অধিকাংশ প্রাণীরই চোখ, কান, নাক এবং মুখ রয়েছে। এগুলো তাদের বেঁচে থাকতে সাহায্য করে।

Figure 4.107: Reflection of summary in TB

[সারসংক্ষেপ]

১৬। প্রত্যেক দল থেকে ১ জনকে দলীয় আলোচনার সারসংক্ষেপ উপস্থাপন করতে বলুন।
১৭। শিক্ষার্থীদের মতামতগুলো বোর্ডে লিখুন।

শিক্ষক সংখ্যা ৪০ চতুর্থ শ্রেণি

প্রাথমিক বিজ্ঞান

প্রশ্ন	উদ্ভিদ	প্রাণী
কীভাবে শক্তি পায়?	সূর্যের আলো, পানি, বায়ু	খাদ্য
কী কী অঙ্গ বা অংশ রয়েছে ?	মূল, কাণ্ড, পাতা, ইত্যাদি	হাত, পা, পাখা, শরীর ইত্যাদি
কীভাবে চলাচল করে ?	উদ্ভিদ চলাচল করতে পারে না	হেঁটে, সাঁতার কেটে, উড়ে ইত্যাদি উপায়ে
কীভাবে সাদা প্রদান করে ?	তথ্যকল্পের প্রতিক্রিয়া দেখায় না	তথ্যকল্পের প্রতিক্রিয়া দেখায়
আরও কিছু ?		

১৮। শিক্ষার্থীদের পাঠ্যপুস্তক খুলতে বলুন এবং আজকের পাঠসংশ্লিষ্ট সারসংক্ষেপ পড়তে বলুন।
১৯। পাঠের মূল প্রশ্নটি করুন, তাদের উত্তর শুনুন এবং যাচাই করুন।
২০। পরবর্তী পাঠে করণীয় সম্পর্কে শিক্ষার্থীদের নির্দেশনা দিন এবং ধন্যবাদ জানিয়ে পাঠ সমাপ্ত করুন।

Figure 4.108: Reflection of summary in TE

The findings of lesson summary from documents analysis (TB & TE), lesson observations and stakeholders' comprehension are presented in the next table.

Table 4.136: Summary of findings about lesson summary

Stakeholders	Stakeholders' comprehension about lesson summary			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of lesson summary	Given information in TE & TB	Way of practice in classroom				In TB	In TE
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-1	lessons-1: somewhat practiced	Somewhat addressed	Somewhat addressed
					Lesson-2	lessons-2: somewhat practiced	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-3	lessons-3: somewhat practiced	Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-4	lessons-4: somewhat practiced	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson-5	lessons-5: somewhat practiced	Somewhat addressed	Somewhat addressed

The findings of the table reveal that T4 and concerned stakeholders have somewhat comprehension of the lesson summary. T4 somewhat focused lesson summary in the science classroom. The information in the lesson summary is somewhat addressed in TB and TE.

➤ **Overall remarks**

Teacher 4's somewhat comprehension of the lesson summary was reflected in T4's classroom practice. Concerned stakeholders' somewhat comprehension may also be reflected in T4's comprehension and classroom practices. Though curriculum documents moderately provided the information of lesson summary but it may not be reflected in T4 and concerned stakeholders' comprehension.

➤ **Overall remarks about the comprehension of the approaches of primary science textbooks and teacher's edition to facilitate inquiry-based teaching**

Teacher has somewhat comprehension about the most of the approaches of TB and TE. Teacher's somewhat comprehension was somewhat reflected in most of the approaches of TB and TE during classroom practices. Students also revealed that, teacher somewhat focuses most of the approaches of TB and TE in the science classroom. Concerned stakeholders' somewhat comprehension about most of the approaches of TB and TE, may be reflected in teacher's comprehension and classroom practices. Most of the identified

approaches addressed somewhat in curriculum documents (TB & TE), but it may be somewhat reflected in T4 and concerned stakeholders' comprehension.

4.21 Employed Learning Opportunities in Inquiry-based Teaching

4.21.1 Step-1. Students are engaged by scientifically oriented questions

Teacher's classroom practice

It has been explored from the observed lessons that, after prior knowledge exploration or review of the previous lesson, the teacher started teaching learning activities. However, the teacher did not engage the students in scientifically oriented question. The next table shows the way of engaging students with a lesson by the teacher.

Table 4.137: Teacher 4's classroom practice about engaging students with scientifically oriented question

Grade & Chapter	ILO	Lesson divided at TE	Lesson topic	Lesson taken by the teacher	Scientifically oriented question mentioned in TB and TE (Key Q.)	Activities done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	Lesson-1	What is the difference between plants and animals	Engaged students with reading book without the scientific question

Stakeholders' views

In the interview, stakeholders were asked about the importance of engaging students with scientifically oriented questions. In response to the question the teacher 4 asserted that,

I engage the students with content related prior knowledge exploring question, so that they can understand what is going to be read today and engage themselves in lessons.

The statement reveals that T4' did not comprehend of scientifically oriented question to engage students.

Besides, stakeholders were asked about the Information provided in TB and TE of engaging students by scientifically oriented question. Among them URCI4 said,

Each lesson in TB starts with a question and of course it may have a reason. It helps the teacher to conduct the class by knowing students' condition through exploring their prior knowledge.

The statement expresses the unawareness of URCI4 about TB and TE. Therefore, URCI4 did not comprehend about the information provided in TB and TE.

In addition, when asked about the way of engaging students in lessons in science classroom. Among the stakeholders PTI instructor 4 said,

I found the teacher showing different teaching aid or doing role play and then asking question to the students to find out the lesson topic. Like, the teacher conducted the topic 'Solar system' and designed a role play with the students then ask them question. It helps the teacher to know students' condition for planning the class.

The above statement expresses that PTI4 did not comprehend about the classroom practice of engaging students with scientifically oriented question.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is a focus on key question to start a lesson. Key question is highlighted at the start of teaching learning activities of each lesson in TB (Figure 4.109). Whereas, it is placed after prior knowledge exploring question and lesson objectives related questions in teaching learning activities in TE (Figure 4.110). Therefore, this approach is extremely addressed in TB and TE.

অধ্যায় ২

উদ্ভিদ ও প্রাণী

১. উদ্ভিদ ও প্রাণীর মধ্যে পার্থক্য

উদ্ভিদ ও প্রাণী উভয়েই জীব। এদের মধ্যে কোনো পার্থক্য লক্ষ করেছ? আমরা কীভাবে উদ্ভিদ ও প্রাণীর মধ্যে পার্থক্য করতে পারি?

প্রশ্ন : উদ্ভিদ ও প্রাণীর মধ্যে কী কী পার্থক্য রয়েছে?

কাজ : উদ্ভিদ ও প্রাণীর বৈশিষ্ট্য

কী করতে হবে :

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

প্রশ্ন	উদ্ভিদ	প্রাণী
কীভাবে শক্তি পায়?		
কী কী অঙ্গ বা অংশ রয়েছে?		
কীভাবে চলাচল করে?		
কীভাবে সাদা প্রদান করে?		
আরও কিছু?		

Figure 4.109: Reflection of scientifically oriented question in TB

শিখন শেখানো কার্যবিধি

- ১। কুশল বিনিময়ের মাধ্যমে শ্রেণিকক্ষে শিখনবাস্তব পরিবেশ তৈরি করুন।
- ২। পাঠ শুরুর পূর্বে শিক্ষার্থীদের পাঠ্যপুস্তক বন্ধ রাখতে বলুন।
- ৩। বোর্ডে অধ্যায়ের নাম ও আজকের পাঠের শিরোনাম লিখুন।
- ৪। শিক্ষার্থীদের খাতায় পাঠের শিরোনাম লিখতে বলুন।

[ভূমিকা]

৫। প্রশ্ন করুন :

জীবকে আমরা কীভাবে ভাগ করতে পারি?

৬। শিক্ষার্থীদের কাছ থেকে উত্তর পাওয়ার জন্য ন্যূনতম ৫ থেকে ৭ সেকেন্ড অপেক্ষা করুন। ৪/৫ জন শিক্ষার্থীর উত্তর শুনুন। (যদি কোনো শিক্ষার্থী স্বতঃস্ফূর্তভাবে উত্তর না দেয় তাহলে একজন শিক্ষার্থীকে নির্বাচন করে তাকে উত্তর দিতে সাহায্য করুন)।

৭। শিক্ষার্থীদের উত্তরের প্রেক্ষিতে অন্য শিক্ষার্থীদের মতামত দিতে বলুন।

৮। শিক্ষার্থীদের উত্তরের সূত্র ধরে আজকের পাঠের উদ্দেশ্য ব্যাখ্যা করুন :

"আজ আমরা উদ্ভিদ ও প্রাণীর পার্থক্য কী তা শিখব। উদ্ভিদ ও প্রাণীর মাঝে আমরা কীভাবে পার্থক্য করতে পারি? উদ্ভিদ ও প্রাণীর মাঝে কী কী পার্থক্য রয়েছে? এগুলোই আমাদের আজকের পাঠের মূল প্রশ্ন। বিভিন্ন কাজের মাধ্যমে আমরা এই প্রশ্নগুলোর উত্তর জানব।"

৯। মূল প্রশ্নটি বোর্ডে লিখুন :

উদ্ভিদ ও প্রাণীর মাঝে কী কী পার্থক্য রয়েছে?

Figure 4.110: Reflection of scientifically oriented question in TE

A summary of the findings of document analysis, lesson observation and stakeholders' comprehension of engaging students by scientifically oriented questions are presented in next table. FGD of stakeholders is also exhibited after that.

Table 4.138: Findings of summary about engaging students by scientifically oriented questions

Stakeholders	Stakeholders' comprehension of engaging students' by scientifically oriented questions			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	Importance of engaging students	Given information in TE & TB	Way of practice in classroom				In TB	inTE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-1	Lesson-1: Did not practice	Extremely addressed	Extremely addressed
					Lesson-2	Lesson-2: Did not practice	Extremely addressed	Extremely addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-3	Lesson-3: Did not practice	Extremely addressed	Extremely addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-4	Lesson-4: Did not practice	Extremely addressed	Extremely addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-5	Lesson-5: Did not practice	Extremely addressed	Extremely addressed

The findings of the table reveal that T4 and concerned stakeholders did not comprehend about engaging students with scientifically oriented questions. T4 did not engage students by scientifically oriented questions. The information is extremely addressed in TB and in TE.

➤ Overall remark

Teacher4's comprehension of engaging students by scientifically oriented questions was reflected in T4's classroom practice. Concerned stakeholders' comprehension may also be reflected in T4's comprehension and classroom practices. Although the information is extremely addressed in curriculum documents, but did not reflect in T4 and concerned stakeholders' comprehension accordingly.

4.21.2 step-2. Learners give priority to evidence, which allows them to develop and evaluate explanations that address scientifically oriented questions.

Teacher's classroom practice

It has been explored from the observed lessons of T4 that, T4 did not give students any opportunity to do the activities and collect data. An observed lesson of T4 is shown in the table where T4 did not form groups with students.

Table 4.139: Teacher 4's classroom practice about giving students priority to evidence in responding to the question

Grade & Chapter	ILO	Lesson divided in TE	Lesson topic	Lesson was taken by the teacher	Scope for students mentioned in TB	Scope for students mentioned in TE	Activities are done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	Lesson-1	-	-give them 5-7 min. to answer -help them to answer	The teacher has given the answer without giving students enough time

Stakeholders' views

Stakeholders were asked, about giving students priority to evidence in responding to the question. The URC instructor4 said,

Each lesson in TB starts with a question and of course it may have a reason. It helps the teacher to conduct the class by knowing students' condition through exploring their prior knowledge.

The statement explores that URCI4 did not comprehend of giving students priority to evidence in responding to the question.

Stakeholders were asked, about the information provided in TE and TB about giving students priority to evidence in responding to the question. PTI instructor said,

I found the teacher showing different teaching aid or doing role play and then asking question to the students to find out the lesson topic. Like, the teacher conducted the topic 'Solar system' and design role play with the students then ask them question. It helps the teacher to know students' condition for planning the class.

The statement explores that URCI4 did not comprehend giving students priority to evidence in responding to the question.

Stakeholders were asked about the classroom practice of giving students priority to evidence in responding to the question. Teacher 4 said,

The students do not know the lesson content earlier. So, first I tell them the Q-A; then they repeat it. For example, when I asked them the available plants name around our class. They did not know trees name that way, so I answer first.

The statement reveal that T4 did not comprehend about the classroom practice of giving students priority to evidence in responding to the question.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE) it is found that, there is scope for the students to collect evidence in responding to scientific question (Figures 4.111 & 4.112).

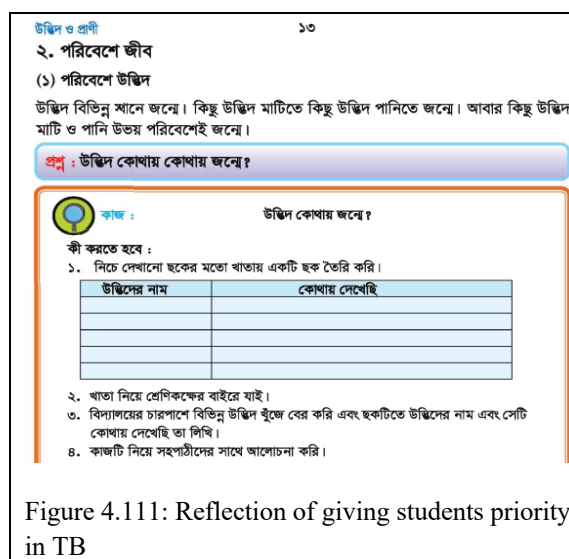


Figure 4.111: Reflection of giving students priority in TB

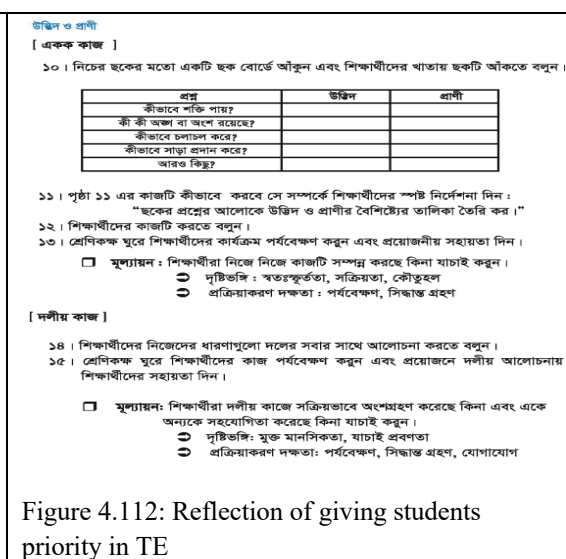


Figure 4.112: Reflection of giving students priority in TE

A summary of the findings of document analysis, lesson observation and stakeholders' comprehension of giving students priority to evidence in responding to the question are presented in the table.

Table 4.140: Summary of the findings of giving students priority to evidence in responding to the question.

Stakeholders	stakeholders' comprehension of giving students priority to evidence in responding to the question			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About the importance of giving students priority	About the information provided in TE & TB	About the practice of giving student priority				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-1	Lesson-1: Did not practice	Moderately addressed	Moderately addressed
					Lesson-2	Lesson-2: Did not practice	Moderately addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-3		Moderately addressed	Moderately addressed

Stakeholders	stakeholders' comprehension of giving students priority to evidence in responding to the question			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About the importance of giving students priority	About the information provided in TE & TB	About the practice of giving student priority				In TB	In TE
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-4	Lesson-3: Did not practice	Moderately addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-5	Lesson-4: Did not practice	Moderately addressed	Moderately addressed

The findings of table reveal that T4 did not comprehend of giving students priority to evidence in responding to the question. However, concerned stakeholders also did not comprehend. T4 did not engage students in responding to the question. The information is moderately addressed in TB and in TE.

➤ Overall remarks

The teacher did not comprehend about engaging students in responding to the question, and this was reflected in T4's classroom practice. The comprehension of concerned stakeholders may be reflected in the teacher's comprehension and classroom practices.

4.21.3 Step-3. Learners formulate explanations from evidence to address scientifically oriented questions

Teacher's classroom practice

It has been explored from the observed lessons that the teacher did not do any activities in the class. Students did not get the opportunity to do the activity. As a result, they could not collect data to make explanation from the evidence. Table shows the teacher's classroom practice to formulate explanation from the evidence by the students.

Table 4.141: Teacher 4's classroom practice to formulate explanations from evidence by the students

Grade & Chapter	ILO	Lesson divided at TE	lesson topic	lesson taken by the teacher	The scope mentioned at TB (Result getting from the activity)	The scope mentioned in TE (Result getting from the activity)	Activities are done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	Lesson-1	Fill-up the table by yourself	Fill-up the table by yourself	-

Stakeholders' views

Stakeholders were asked to formulate explanations from evidence from the students. The AUEO4 said,

Teacher never asks students to explain the answer. As soon as he/she gets the answer to the lesson related question, then start the main topic. Basically, the lesson is new to the students, they can't give an explanation of answer, the so teacher does not want to waste time.

The statement reveals AUEO4 did not comprehend of formulating explanations from evidence by the students.

Stakeholders were asked, about the information provided in TE and TB to formulate explanations from evidence by the students. URC instructor4 said,

More or less TB and TE provided the information or instruction for the teacher-what they have to do in each step of teaching learning but our teacher do not follow it that way.

The statement reveals URCI4 did not comprehend the information provided in documents.

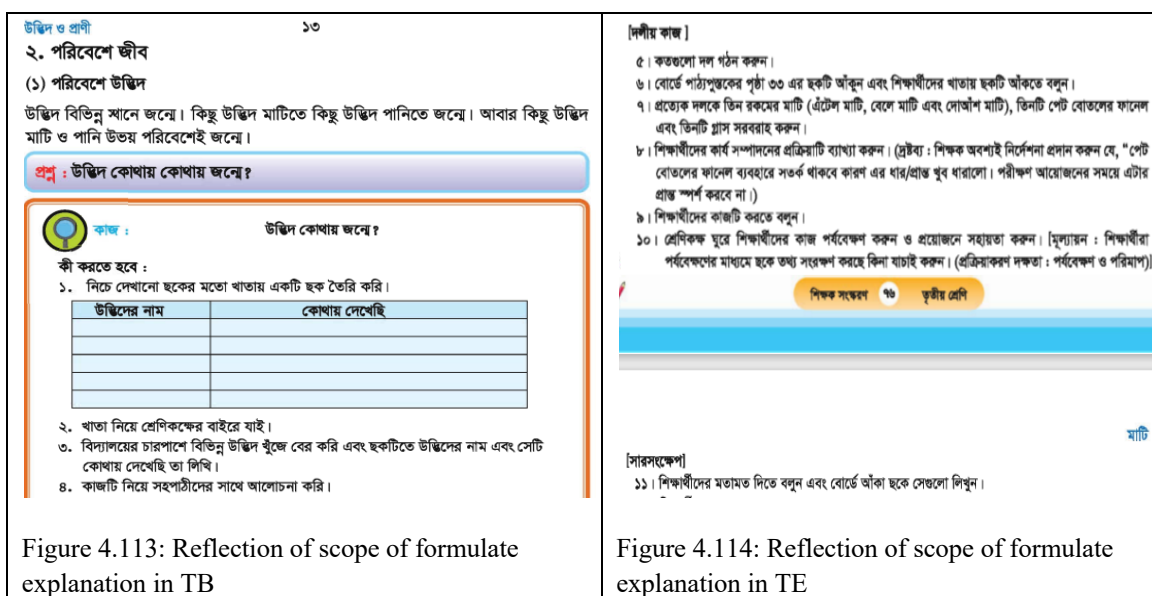
Stakeholders were asked, about the classroom practice of formulating explanations from evidence by the students. Teacher 4 said,

Most of the time students cannot give explanation of their answer from evidence as they do not know about the lesson earlier and cannot link the topic with the activity.

The statement reveals T4 did not comprehend the classroom practice of formulating explanations from evidence by the students.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is opportunity for the students to formulate explanation of the scientific question through activity (Figures 4.113 & 4.114)



➤ Overall remarks

The teacher⁴ did not comprehend of formulating explanations from evidence by the students, and this was reflected in T4's classroom practice. The comprehension of concerned stakeholders may be reflected in the teacher's comprehension and classroom practices.

4.21.4 step-4. Learners evaluate their explanations in light of alternative explanations, particularly those reflecting the scientific understanding

Teacher's classroom practice

It has been explored from the observed lessons that, the teacher filled the provided blank table on the board by own self, and directed the students to read their books. Therefore, T4 gave students some opportunity to evaluate the explanation in light of alternative interpretations. A lesson exercise of T4 is shown in the next table.

Table 4.143: Teacher 4's classroom practice about learners evaluating their explanations in light of the alternative explanation

Grade & Chapter	ILO	Lesson divided in TE	Lesson topic	Lesson taken by the teacher	Scope mentioned in TB	Scope mentioned in TE	Activities done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	Lesson-1	Group discussion	-Group discussion after fill-up the table -summarize by one group member -write on board	Instruct the students to read the book

Stakeholders' views

To know about this, stakeholders were asked, about providing students opportunity to evaluate their explanations in light of alternative explanations. The AUEO⁴ said,

All students did not give same answer. The teacher direct said its ok after receiving write answer from anyone and all students gave clap, but did not say wait let check others and compare with their answer to get complete answer.

The statement reveals T4 did not comprehend of giving students the opportunity to evaluate their explanations in light of alternative explanations.

Stakeholders were asked, about the information providing students opportunity to evaluate their explanations in light of alternative explanations. PTI instructor⁴ said,

There may be information at TB and TE about teacher's role to evaluate students' answer, actually I did not notice that way.

Stakeholders were asked, about the classroom practice of giving opportunity to evaluate their explanations in light of alternative explanations. URC instructor¹ said,

Teacher do not practice it in classroom. They ask question to the students, 2-3 students can reply or not, teacher do not give more attention on assessment, only reading is the main focus.

The statement explores URCI⁴ did not comprehend the information providing students the opportunity to evaluate their explanations in light of alternative explanations.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is given opportunities for the students to evaluate their explanation in light of alternative explanation (Figures 4.115 & 4.116).

উদ্ভিদ ও প্রাণী ১৩

২. পরিবেশে জীব

(১) পরিবেশে উদ্ভিদ

উদ্ভিদ বিভিন্ন স্থানে জন্মে। কিছু উদ্ভিদ মাটিতে কিছু উদ্ভিদ পানিতে জন্মে। আবার কিছু উদ্ভিদ মাটি ও পানি উভয় পরিবেশেই জন্মে।

প্রশ্ন : উদ্ভিদ কোথায় কোথায় জন্মে?

কাজ : উদ্ভিদ কোথায় জন্মে?

কী করতে হবে :

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

উদ্ভিদের নাম	কোথায় দেখেছি

২. খাতা নিয়ে শ্রেণিকক্ষের বাইরে যাই।

৩. বিদ্যালয়ের চারপাশে বিভিন্ন উদ্ভিদ খুঁজে বের করি এবং ছকটিতে উদ্ভিদের নাম এবং সেটি কোথায় দেখেছি তা লিখি।

৪. কাজটি নিয়ে সহপাঠীদের সাথে আলোচনা করি।

Figure 4.115: Reflection of opportunity to evaluate students' explanation in TB

[সারসংক্ষেপ]

১২। প্রত্যেক দল থেকে ১ জনকে দলীয় আলোচনার সারসংক্ষেপ উপস্থাপন করতে বলুন।

১৩। শিক্ষার্থীদের মতামতগুলো বোর্ডে লিখুন।

উদ্ভিদের নাম	কোথায় দেখেছি?
আম	মাটিতে, স্যান্ডবোর্ডে স্থান ইত্যাদি।
ফার্ন (টেকি শাক)	মাটিতে, পাথরের নিচে, ছায়ায় ইত্যাদি।
মস	পাথর বা দেয়ালের উপরে, ছায়ায় স্থানে
শাপলা, কচুরিপানা	পানিতে

১৪। শিক্ষার্থীদের পাঠ্যপুস্তক খুলতে বলুন এবং আজকের পাঠসংশ্লিষ্ট সারসংক্ষেপ পড়তে বলুন।

১৫। পাঠের মূল প্রশ্নটি করুন, তাদের উত্তর শুনুন এবং যাচাই করুন।

১৬। পরবর্তী পাঠে করণীয় সম্পর্কে শিক্ষার্থীদের নির্দেশনা দিন এবং ধন্যবাদ জানিয়ে পাঠ সমাপ্ত করুন।

মূল্যায়ন : নমুনা প্রশ্ন

- আবাসস্থল বলতে কী বোঝায়?
- উদ্ভিদের আবাসস্থল কী কী?
- স্থানমূলযুক্ত উদ্ভিদ কী ধরনের পরিবেশে জন্মায়? এ জাতীয় উদ্ভিদের তিনটি নাম লিখ?

Figure 4.116: Reflection of opportunity to evaluate students' explanation in TE

Table 4.145 presented a summary of the findings of document analysis, lesson observation and stakeholders' comprehension of giving opportunity to evaluate their explanations in light of alternative explanations.

Table 4.144: Summary of findings about evaluate students' explanations in light of alternative explanations.

Stakeholders	stakeholders' comprehension of giving opportunity to evaluate students' explanations in light of alternative explanations.			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About evaluate students explanations	About the information provided in TE & TB	About the practice of giving student priority				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-1	Lesson-1: Did not practice	somewhat addressed	Moderately addressed
					Lesson-2	Lesson-2: Did not practice	somewhat addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-3	Lesson-3: Did not practice	somewhat addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-4	Lesson-4: Did not practice	somewhat addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-5	Lesson-5: Did not practice	somewhat addressed	Moderately addressed

The findings of table reveal that T4 and concerned stakeholders did not comprehend giving opportunity to evaluate students' explanations in light of alternative explanations. T4 did not give opportunity to evaluate students' explanations in light of alternative explanations. The information is somewhat addressed in TB and moderately addressed in TE.

➤ Overall remarks

The teacher did not comprehend giving opportunity to evaluate students' explanations in light of alternative explanation, and this was reflected in T4's classroom practice. Concerned stakeholders also did not comprehend, which may be reflected in the teacher's comprehension and classroom practices.

4.21.5 Step-5. Learners communicate and justify proposed explanations

Teacher's classroom practice

It has been explored from the observed lessons that, T4 did not form groups or directs the student' to form groups for group discussion. Therefore, students' do not have the opportunity to communicate with each other and justify the explanation. A lesson exercise of T4 is shown in Table.

Table 4.145: Teacher 4's classroom practice about students' communication with each other's and justify their explanation

Grade & Chapter	ILO	Lesson divided in TE	lesson topic	lesson taken by the teacher	scope mentioned in TB	scope mentioned in TE	Activities done by the teacher
G-4 C-2: plant and animal	2.2.1	1	Difference between plants and animal	Lesson-1	Group discussion	-instruct the students to read out lessons summary -assess and justify them with today's key question	Did not form group

Stakeholder' views

Stakeholders were asked about the students' communication with each other's and justify their explanations. The URC instructor⁴ said,

Teachers has no intention to assess the students that way, they only ask them question after ending the lesson, but do not follow or maintain any strategy or instruction, they instruct students to read TB for matching the answer.

The statement explores that, URCI⁴ did not comprehend about the inquiry approach students' communication with each other's and justify their explanations.

Stakeholders were asked about the information provided in TE and TB about the students' communication with each other's and justify their explanations. AUEO⁴ said,

‘May be in TB and TE but actually I did not notice it that way’.

The statement explores that, T⁴ did not comprehend the information provided in TE and TB about the students' communication with each other's and justify their explanations.

Stakeholders were asked about the classroom practice of students' communication with each other's and justify their explanations. Teacher 4 said,

Actually, I told students to follow other's answer then read the book and match the answer with TB content, I receive answer from several students so that they can memorize it.

The statement reveals that T⁴ did not comprehend about classroom practice of students' communication with each other's and justify their explanations.

Information provided in TB and TE

Analyzing the primary science textbooks (TB) and teacher's editions (TE), it is found that there is given some opportunities in TB and moderate opportunity in TE for the students to communicate with others and justify their explanation through group discussion (Figures 4.117 & 4.118).

আলোচনা

কোন কোন পরিবেশে জীব বাস করে?

১. নিচে দেখানো ছকের মতো খাতায় একটি ছক তৈরি করি।

বাসস্থান	উদ্ভিদ	প্রাণী
মরুভূমির পরিবেশ		
বনজ পরিবেশ		
জলজ পরিবেশ		
সামুদ্রিক পরিবেশ		
মেঘু অঞ্চলের পরিবেশ		

২. ছকে উল্লিখিত আবাসস্থলগুলোতে থাকে এমন উদ্ভিদ ও প্রাণীর তালিকা তৈরি করি।

৩. সহপাঠীদের সাথে আলোচনা করে কাজটি সম্পন্ন করি।

শিক্ষক সংস্করণ ৩৫ চতুর্থ পৃষ্ঠা

[দলীয় কাজ]

৭। শিক্ষার্থীদের কয়েকটি দলে ভাগ করুন।

৮। বোর্ডে একটি ছক আঁকুন এবং শিক্ষার্থীদের নিজেদের খাতায় ছকটি আঁকতে বলুন।

পরিবেশের পরিবর্তন হলে উদ্ভিদ ও প্রাণীর কী ঘটবে?

৯। কীভাবে কাজটি করবে সে সম্পর্কে শিক্ষার্থীদের স্পষ্ট নির্দেশনা দিন:
“পরিবেশের পরিবর্তন হলে উদ্ভিদ ও প্রাণীর জীবনে কী ঘটবে? এই বিষয়টি নিয়ে আলোচনা কর এবং ছকে একটি তালিকা তৈরি কর।”

শিক্ষক সংস্করণ ৫৫ চতুর্থ পৃষ্ঠা

উদ্ভিদ ও প্রাণী

১০। শিক্ষার্থীদের কাজটি সম্পন্ন করতে বলুন।

১১। শ্রেণিকক্ষ ঘুরে শিক্ষার্থীদের কার্যক্রম পর্যবেক্ষণ করুন এবং প্রয়োজনে সহায়তা প্রদান করুন।

Table 4.146: Summary of findings about students' communication with each other's and justify their explanations.

Stakeholders	Participants view about students' communication with each other's and justify their explanations			Overall comprehension	No. of ILO in Grade Four	Teacher's lesson practice	Information provided (Based on literature review)	
	About justify students explanations	About the information provided in TE & TB	About the practice of giving student priority				In TB	In TE
Teacher	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-1	Lesson-1: Did not practice	somewhat addressed	Moderately addressed
					Lesson-2	Lesson-2: Did not practice	somewhat addressed	Moderately addressed
PTI instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-3	Lesson-3: Did not practice	somewhat addressed	Moderately addressed
URC instructor	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-4	Lesson-4: Did not practice	somewhat addressed	Moderately addressed
AUEO	Not comprehend	Not comprehend	Not comprehend	Not comprehend	Lesson-5	Lesson-5: Did not practice	somewhat addressed	Moderately addressed

The findings of table reveal that T4 and concerned stakeholders did not comprehend about learners' communication with each other's and justify their explanations. T4 did not give

opportunity to learners' communication with each other's and justify their explanations. The information is somewhat addressed in TB and moderately addressed in TE.

➤ **Overall remarks**

Teacher 4's comprehension about giving opportunity to learners communicate with each other's and justify their explanations was reflected in T4's classroom practice. Concerned stakeholders' comprehension may also be reflected in the teacher's comprehension and classroom practices.

➤ **Overall findings on given learning opportunities provided for inquiry-based teaching**

Teacher 4 did not comprehend inquiry approaches. T4's comprehension of inquiry was reflected in the classroom as T4 did not practice inquiry-based teaching in the science classroom. Students also revealed that the teacher did not focus on inquiry approaches in the science classroom. Concerned stakeholders did not comprehend the inquiry approaches; that may be reflected in teachers' comprehension and classroom practices. Curriculum documents (TB & TE) mostly addressed moderately the inquiry approaches.

4.22 Comprehension of Practiced Assessment Methods (formative and summative) to Assess ILOs

The following section presents the results of the comprehension of practiced assessment methods: summative and formative, through document analysis, lesson observation and interviews.

4.22.1 Formative assessment: areas and tools

Provided information in TB, TE and AG

The following table 4.148 presents the data from documents analysis and lesson observations of assessment areas (cognitive knowledge, science process skills; scientific attitude and values) and assessment tools (Oral and written). Analyzing the primary science textbooks (TB), teacher's editions (TE) and assessment guide (AG) it is found that, the information provided for lesson-2 adequately addressed in TE following the AG instruction but did not address in TB that way.

Table 4.147: Information provided for formative assessment areas and assessment tools

Selected assessment areas, sub-areas and tools in Assessment Guide			Assessment focused at TE		Assessment focused at TB		Assessment practiced by the teacher	
areas	sub-areas	tools	Assessment areas	Assessment tools	Assessment areas	Assessment tools	Assessment areas	Assessment tools
cognitive Knowledge	remembering	oral assessment checklist	knowledge	questions	knowledge	questions	knowledge	oral questions
	understand							
	application	written questions						
	higher order learning							
science process skills	observation	observation checklist	observation	Verify students' classwork				
	measurement							
	classification	oral checklist	decision making	Verify students' answer				
	prediction							
	decision making	written questions	communication					
	experiment							
communication								
scientific attitude and values	interest	observation checklist	open mindedness	Verify students' active participation in group discussion	positive attitude			
	curiosity							
	open mindedness							
	curious on verification							

Teacher's classroom practice

It is found in the table that T4 focused only on knowledge for assessment through oral questions in the lesson 2. T4 did not focus on any scientific skills and attitude, and did not focus any other tools which are also mentioned in TE. Therefore, T4 somewhat practiced the mentioned assessment areas and tools.

Stakeholder' views about formative assessment method: areas and tools

Formative assessment areas

Stakeholders were asked about the focus areas of formative assessment during classroom assessment. The PTI instructor⁴ said,

The classroom assessment focus is learning outcome. knowledge, application and understand are focused areas for assessment.

The statement states PTII⁴'s somewhat comprehension of the focus areas of formative assessment.

To know stakeholders' knowledge about the information provided in documents, they were asked about the scopes of assessment areas on given activities in TE and TB with an example. Teacher 4 said,

Actually, we have to do many works along with our classes of different subjects and different grades. So, we couldn't concentrate on each subject in TB and TE deeply. Actually, I try to follow TB but I could not understand TE.

The explanation reveals T4's unawareness of the information provided in the documents, as T4 did not understand TE.

Stakeholders were asked about teacher's classroom practice of formative assessment areas. AUEO4 said,

Teachers assess only students' knowledge level they can't focus on understand and application level.

The statement reveals that AUEO 4 has somewhat comprehension about the assessment focus areas.

Formative assessment tools

Stakeholders were asked about the scope of assessment tools in the provided activities of TE and TB. The teacher 4 said,

I become too busy with my class and other activities in schools that I could not get chance to see the TE and TB that way, but I follow TB for classroom assessment.

Here, the unawareness of T4 is explored in the statement, as T4 only follows TB for classroom assessment. T4 have somewhat comprehension about classroom assessment tools.

Stakeholders were asked about the assessment tools practice in classroom. URC instructor4 said,

There are two processes for classroom assessment: oral and written, teachers usually use oral questions for assessment and sometimes use written questions.

In the statement, it reveals that URCI4 has somewhat comprehension of the classroom assessment process.

A summary finding of stakeholders' comprehension of formative assessment method is presented in table 4.149.

Table 4.148: Findings of stakeholders' comprehension of formative assessment methods

Stakeholders' comprehension of formative assessment: areas and tools						Overall comprehension of formative assessment areas and tools
Stakeholders	Areas of formative assessment	Information on formative assessment areas in TB & TE	Views about classroom practice of assessment areas	Information on formative assessment tools in TB & TE	Views about classroom practice of assessment tools	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table reveals that, teacher and concerned stakeholders have somewhat comprehension about the areas and tools of formative assessment. However, they also have somewhat comprehension of TB and TE provided information. Moreover, teachers and concerned stakeholders have somewhat comprehension of classroom practice of formative assessment areas and tools.

The summary of findings about the information provided in TB and TE; and level of T1's practiced assessment methods in the classroom and stakeholders' views is shown in the next table.

Table 4.149: Summary of findings about formative assessment methods

Stakeholders	Stakeholders' comprehension of formative assessment methods			Overall comprehension of assessment methods	Chapter, Lesson & No. of ILO in Grade three	Teacher's lesson practice	Information provided (Based on literature Review)		
	About areas of formative assessment	About given Information in TB & TE	About way of classroom assessment				In TB	In TE	In AG
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson:1	Lesson-1: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
PTI instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson:2	Lesson-2: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
URC instructor	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat Comprehend	Lesson:3	Lesson-3: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed
AUEO	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Lesson:4	Lesson-3: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed

Stakeholders	Stakeholders' comprehension of formative assessment methods			Overall comprehension of assessment methods	Chapter, Lesson & No. of ILO in Grade three	Teacher's lesson practice	Information provided (Based on literature Review)		
	About areas of formative assessment	About given Information in TB & TE	About way of classroom assessment				In TB	In TE	In AG
					Lesson:5	Lesson-4: Somewhat practiced	Somewhat addressed	Somewhat addressed	Somewhat addressed

It is found from the table that teacher and concerned stakeholders have somewhat comprehension of formative assessment methods. It also explores that, T4 somewhat practiced formative assessment, as T4 did not focus on assessment areas and did not practice assessment tools as such in the classroom. The information on formative assessment areas and assessment tools are somewhat addressed in AG, TE and TB.

➤ Overall remarks

The teacher has somewhat comprehension of formative assessment methods, and this was reflected in T4's classroom practice. Concerned stakeholders also have somewhat comprehension, and this may be reflected in the teacher's comprehension and classroom practices. Curriculum documents addressed somewhat, and this may be also reflected in teacher and concerned stakeholders' comprehension and teacher's classroom practice.

4.22.2 Summative assessment: areas and tools

Stakeholder' views about summative assessment

To know stakeholders views they were asked about the areas of summative assessment. Teacher 4 said,

I do not get chance to prepare question, usually experienced master trainers do it centrally in groups in Upazila, the focusing areas of summative assessment are knowledge, understand, application. I do assess the exam sheets following the areas and numbers mentioned in question.

The statement reveals that T4 did not get the opportunity to develop summative assessment question and has somewhat knowledge about the focusing areas of summative assessment, as T4 stated knowledge, understand and application. Therefore, T4 has somewhat comprehension of the areas of summative assessment.

In response to a question asked about the instructions given in the documents (TE, TB & AG) specifying the areas of summative assessment areas, URC instructor 4 replied,

There are questions at the end of each chapter in TB and TE; but no other instruction was provided regarding summative assessment, the teachers follow the marking scheme provided by NCTB to assess the answer script.

The statement reveals that URCI4 has somewhat comprehension of the instruction provided in documents for summative assessment.

Stakeholders were asked about the development of summative assessment question. AUEO4 replied,

There are a committee with expert person to prepare question centrally in Upazila; the question disseminates in all the schools of the Upazila. The teacher assesses the answer sheet following marking scheme or sometimes we instruct them to prepare their own marking scheme following NAPE.

The statement reveals that only a few selective expert persons are involved in developing summative assessment questions. AUEO4 did not engage in developing questions but had some knowledge about the development of summative assessment questions.

A summary finding of stakeholders' comprehension of the summative assessment method is presented in the next table, where areas of assessment, information provided in documents, and the development process of assessment questions are included.

Table 4.150: Stakeholders' comprehension of the summative assessment method

Participants	Stakeholders' comprehension of summative assessment method			Overall comprehension
	Focusing areas of assessment	Information provided at documents about assessment areas	Development of summative assessment question	
Teacher	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
AUEO	Moderate comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend

The table reflects that the teacher and concerned stakeholders have moderate comprehension about the focusing areas of summative assessment. Moreover, they have somewhat comprehension about the provided information in the documents and question development. Therefore, the stakeholders have somewhat comprehension about summative assessment method.

Practiced summative assessment questions in the school

The collected summative assessment question is analyzed focusing on areas and tools, and the findings are presented in the next table.

Table 4.151: Areas and tools of the practiced summative assessment

Types of questions	Cognitive knowledge								Total no of Q.	Total number of different Q.
	Remembering		Understanding		Applying		Higher order learning			
	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.	No of Q.	Provided number for each Q.		
Short Q.	4	4×2=8	1	1×2=2	1	1×2=2	-	-	6	12
Fill in the blanks	5	5×1=5	5	5×1=5	-	-	-	-	10	10
Matching	5	5×2=10	-	-	-	-	-	-	5	10
Narrative Q.	5	5×10=50	-	1×8=8	2	2×5=10	-	-	8	68
Total	-	73%	-	17%	-	12%	-	-	29	100

The table reveals that the practiced summative assessment question covered a maximum of almost 73% of focusing on remembering whereas, applying covered only almost 12%. There are found an anomaly in the question, where 4 questions within 29 were repeated. However, there is no marks distribution for a fraction of questions in narrative part, which can confuse teachers to mark against each question.

The findings of analyzed summative assessment question, and the information provided by NCTB and assessment guide (AG) for preparing summative assessment questions are presented in the next table.

Table 4.152: Findings from the document analysis about summative assessment method

Areas and percentage of knowledge for summative assessment			
Areas of knowledge	% of practiced questions	proposed % from NCTB	Proposed % from assessment guide
remembering	73	20	30
understanding	17	30	30
applying	12	30	30
HOT	-	20	10

The table explores that the maximum % number was from remembering and the minimum % number was from applying, and higher order thinking (HOT) is absent in practiced summative questions. However, there is a big gap in remembering 73% and applying 12% of areas in the analyzed question. NCTB suggested 20% and assessment guide (AG)

suggested 30% from remembering. In the case of applying, both NCTB and AG suggested 30 %. Therefore, the practiced summative question did not follow the provided instructions for preparing questions.

➤ **Overall remarks**

The teacher and concerned stakeholder did not have the opportunity to be involved in the summative assessment question development. However, they were somewhat comprehending about summative assessment method. The practiced summative assessment question did not follow the instruction given in the documents, and this may be reflected in the teacher and concerned stakeholders' comprehension.

➤ **Overall remarks on assessment methods**

The teacher and concerned stakeholder have somewhat comprehend assessment methods. Stakeholders' comprehension may be reflected in teacher's comprehension and practice.

4.23 Comprehension about the Extent of Students' Achievement of ILO

4.23.1 The extent of students' achievement of ILOs by formative assessment

Stakeholders' view on the extent of students' achievement of ILOs

To know the stakeholders' view, they were asked 'How to understand to what extent the ILOs have been achieved during conducting lessons. The PTI instructor⁴ said,

Students answering approaches of spontaneity and silence help teachers to understand how much students' LO has been achieved.

The statement reveals PTII⁴'s somewhat comprehension about the extent of students ILO achievement.

To know stakeholders view, they were asked about the information provided in AG, TB and TE to assess the extent of achieving the ILOs through formative assessment. in response the AUEO⁴ said,

Teachers assess the students in each class with the help of the questions provided in TB and TE or they create their own questions and evaluate the students in class. We have also formatted structure for classroom assessment.

The statement reveals that AUEO4 aware of the provided information in TB, TE and the provided formatted structure for formative assessment. Therefore, AUEO4 was a moderate comprehension of the information provided in documents.

To know the classroom practice, stakeholders were asked about the practice to assess the extent of students' achievement of the ILOs through formative assessment. Teacher 4 stated,

Students' achievement can be known by question-answer during class time focusing knowledge, understand and application.

The statement reveals T4's explanation on the way of assessing the extent to achieve the ILOs during conducting lessons without following any given instruction or format. This explanation revealed the unawareness of T4, from which it can be understood that T4 was somewhat comprehended about formative assessment.

A summary of findings is presented in the next table, where stakeholders' comprehension of formative assessment extent is included by their views about the importance of formative assessment extent, about the information provided in documents of the formative assessment extent, and about the practice of the extent of formative assessment.

Table 4.153: Summary of findings of stakeholders' comprehension of the extent of formative assessment.

Stakeholders	Stakeholders view the extent of achieving the ILOs through formative assessment			overall comprehension about the extent of ILO achievement through formative assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE about formative assessment extent	The practice of the extent of ILO achievement	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Moderate comprehend	Moderate comprehend	Moderate comprehend
AUEO	Moderate comprehend	Moderate comprehend	Moderate comprehend	Moderate comprehend

The table explores that among the stakeholders, two academic supervisors have moderate comprehension about the extent to which the ILOs have been achieved through formative assessment. However, T4 and one concerned stakeholder have somewhat comprehension as they were unaware of the information provided in documents that reflected in their understanding.

4.23.2 The extent of students' achievement of ILOs by summative assessment

Stakeholders' view about the extent of students' achievement of ILOs by summative assessment

Stakeholders were asked 'How do you understand the extent of students' ILO achievement by summative assessment? The AUEO4 said,

The focus of summative assessment is knowledge, understanding and application. Thus, summative assessment is performed in stages with two types of direct questions: short response questions (SRQ) and constructive response questions (CRQ). The teachers assess answer script following marking scheme.

In the statement AUEO4 states the summative assessment methods: question types and assessment system by the teacher, which reveals AUEO4's moderate comprehension about the extent of students' ILO achievement by summative assessment.

Stakeholders were asked about the information provided in AG, TB and TE to assess the extent of students' achievement of ILOs. URC instructor4 said,

There are questions at the end of each chapter in TB and TE for summative assessment. Teacher assesses the answer script following the marking skim provided by NAPE or the given number against each question in the question paper.

The statement explores that URCI4 has moderate about the extent of students ILO achievement by summative assessment.

Stakeholders were asked about the practice of students' assessment to achieve the ILOs by summative assessment. The teacher 4 said,

Questions are prepared to name a, b, c with numbers for knowledge, understanding and application in the summative assessment question paper, and I follow numbers against each question to assess.

The statement explores the summative assessment process of T4, where T4 follows the instruction given in question to assess the answer script that reveals T4 has somewhat comprehension about the extent of students' ILO achievement by summative assessment.

A summary of the findings of stakeholders' comprehension of the extent of students' achievement of ILOs by summative assessment is shown in the next table.

Table 4.154: Summary of findings of stakeholders' comprehension about the extent of students' achievement of ILOs by summative assessment

Stakeholders	Stakeholders view about the extent of students ILO achievement by summative assessment			overall comprehension about the extent of students ILO achievement by summative assessment
	Understanding of the extent of ILO achievement	Information provided in AG, TB & TE	Teacher's assessment system	
Teacher	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
PTI	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend	Somewhat comprehend
URC	Moderate comprehend	Somewhat comprehend	Moderate comprehend	Moderate comprehend
AUEO	Moderate comprehend	Somewhat comprehend	Moderate comprehend	Moderate comprehend

From the table it states that the teacher and one concerned stakeholder have somewhat comprehension of the extent of students' achievement of ILOs by summative assessment. However, two concerned stakeholders have moderate comprehension.

➤ Overall remarks

The teacher has somewhat comprehension of the extent of students' achievement of ILO by both the formative and summative assessment. Concerned stakeholders have somewhat to moderate comprehension in both the assessment, and this may be reflected in teachers' comprehension and practices.

➤ Overall remarks about the extent of students' achievement of ILOs

The teacher has somewhat comprehension of the extent of students' achievement of ILOs. Mostly, concerned stakeholders have moderate comprehension; that may be reflected in teachers' comprehension and practices.

4.24 Challenges to Practice Inquiry in the Science Classroom

Challenges of practicing inquiry in the science classroom

This study finds the most significant challenges from case A to the successful implementation of inquiry-based teaching in teacher and concerned stakeholders' interview sessions and these are presented in the next.

1. The threat of time management:

Time for an inquiry-based science lesson preparation for learners' meaningful learning in class has been identified as a reason why teachers do not prefer inquiry-based methods. In this context. AUEO4 said,

Our teachers have many classes in a day and have to do different types of work. So, they do not get enough time to get ready for an activity-based class.

URC Instructor4 said,

Teachers have to do many tasks in school along with class; so they cannot get interested in activity-based classes and cannot manage time to get ready for an inquiry-based class.

In the statements time management is mentioned as a reason for not practicing activity in the science classroom.

2. Deficiency in inquiry-based instructional techniques and strategies:

The appropriate knowledge of content and pedagogy considered teachers' overall instructional methods, strategies, and skills with a specific focus on the inquiry-based lesson. In line with this Teacher4 said,

I have to prepare different lessons in different subjects for different grades in a day. I have to switch from one subject to another and so can't concentrate on any one subject as such, and can't prepare lessons that way do not get the chance to think on a lesson of one subject.

PTI Instructor4 said,

Though teachers get training for professional development; however, they cannot engage themselves with the content and pedagogy of activity-based classes that way. They have lacking to do activities with proper instruction and strategies.

The statements reveal that lack of content and pedagogical knowledge prevent them to follow proper instructional methods, strategies and skills with a specific focus on the inquiry-based lesson.

3. Resources available at the schools: Human and physical

Although science recognizes as a core subject in the primary curriculum, many primary school teachers lack the confidence to teach science lessons because they are not subject specialists. The availability of resources can boost teachers' confidence. AUEO4 asserted,

There is not enough space and maintenance system at school to store the resources provided by the government for teachers. Teachers have to do all the activities along with self-made teaching materials. So, they lost their interest to do activity-based classes.

URCI4 stated,

Teachers need necessary equipment in a required quantity; classroom and lab facilities; access to outside space; and ICT and technical support to implement activities in science class successfully.

In the statements it explores that subject knowledge and availability of resources cause problems to practice inquiry in the science classroom.

4. The difficulty of assessment

Summative assessment may not be suitable for inquiry-based learning as inquiry skills are not content-bound. So, paper and pencil tests create challenges to the implementation of inquiry science as it assesses only knowledge and cognitive processing. T4 claimed,

I do not understand how could I assess students based on their activity, I only asked them questions in class to know how much they memorize their lesson and assess through written exams. Centrally.

PTII4 said,

Students' achievement of inquiry-based learning can be assessed during the investigation process through a formative assessment where some skills with knowledge are also focused. Summative assessment is not aligned with inquiry-based learning properly.

In the statements, it reveals that the difficulty of assessment systems creates to assess students' inquiry-based learning.

5. Lack of motivation

Inquiry requires a higher level of motivation for both teachers and students. If they are not sufficiently motivated, they either lose their interest to participate or participate in a disengaged way in inquiry activities, and that does not support learning. PTII4 said,

Teachers do not get interested to do activities in science classes; they think it needs time and is more difficult to handle students rather than the traditional class system. They do not motivate anyway.

AUEO4 asserted,

Teachers have to do many works along with classes in school, they want convenient ways to conduct classes and select the traditional way which is to conduct classes with reading books.

In the above statements reveals lack of motivation as an obstacle for inquiry.

6. Accessibility of investigating techniques

Scientific investigation requires a level of precision and care that are not needed for students' other learning. T4 said,

To engage students with activities, the tools must be easy to handle for them. I become afraid that what things I supply them to do the activity as an alternative when instructed tools are not available.

URCI4 said,

Teachers claimed not to do activities in science classrooms or the availability of the tools. All the instructed tools are not available and they have to think of alternative things. So accessibility of tools for activity class is needed for students.

The statements reveal students' accessibility of investigation technique as an obstacle for inquiry.

7. Management of extended activities

Students need not do any extended complex processes as part of traditional learning activities. So, if they are unable to organize or manage any extended process for inquiry, they cannot engage in inquiry properly and cannot achieve the goal of inquiry-based learning. T4 said,

Primary level students are not that sincere or capable to do any activity in the science classroom. if it needs more than simple work, they may more unable to do the extended activities.

AUEO4 asserted,

Students in elementary grades cannot read properly. They are too young to do any activity, they cannot do simple activities in the classroom. so if the activity needs an extended complex process, it is impossible to do for them.

The statements reveal management to extend the activity and prevent to do inquiry.

8. The practical constraints of the learning context

The technologies and activities of inquiry-based learning must be suitable for the practical obstacle of the learning environment like available resources and fixed schedules (Edelson. Et al., 1999). The school environment, infrastructure, student cooperation, and available resources are most important for inquiry learning. PTII4 said,

Maximum primary schools are not much structured and resourceful to do activities in the classroom. Teachers have to manage everything. As a result, they lose their interest in activity class.

URCI4 said,

It is a challenge for the teacher to maintain the teaching aids needed for activities or prepare it within a short time; maximum time they become busy with classes and other activities. Sometimes it is not possible to do activity-based classes practically.

The statements reveal practical constraints of the learning context is a vital cause to do inquiry.

4.25 Effect of Existing Alignment on Developing Curriculum Documents

Science education experts have given their opinion about the effect of existing alignments on developing curriculum documents. On the basis of the findings of the existing situation of primary science teaching practice and the identified challenges, science education experts have given their views. According to them, teachers, concerned stakeholders, and curriculum documents all are accountable for this existing situation of primary science teaching practice. Figure 4.119 presents the process of generating effect of existing alignments on developing curriculum documents.

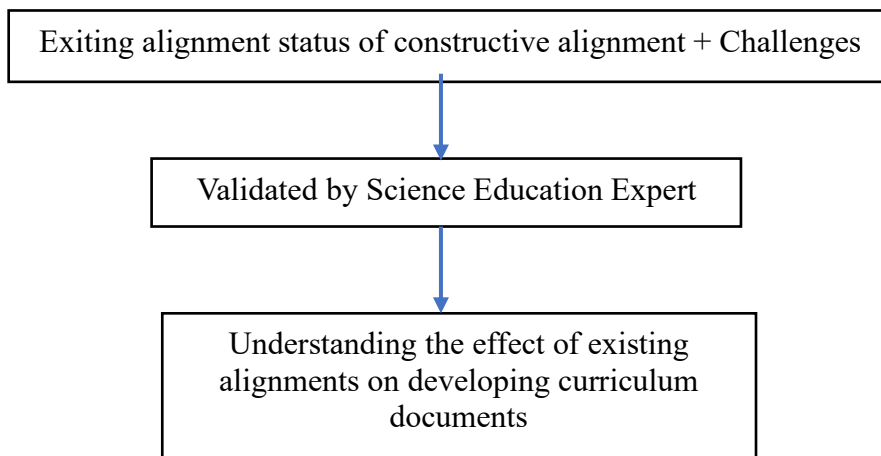


Figure 4.119: Process of generating the central question of the study

4.25.1 Science education expert views

Experts were asked to give opinions about the situation that, comprehension of primary science teachers was somewhat about the focus of ILOs in line with inquiry-based teaching-learning, as well as there are some challenges like inappropriate professional development programs, lack of collegial supervision, lack of background knowledge in content and pedagogy, and lack of motivation, insufficient guides for connecting curriculum and inquiry teaching. Expert A opined,

ILOs are the main focus of lessons in teaching-learning and that should be clear to the teacher what she/he is going to focus on in the lesson. Teachers' comprehension reflects on classroom practice. Teachers' comprehension mainly depends on his/her own knowledge of content and pedagogy; and the supportive documents and supportive academic persons. Proper training and guidance also motivate teachers to develop their understanding. The situation of the understanding of ILOs impact on teaching-learning; and also, the student's achievement of ILOs.

The statements explore that, the situation of understanding of ILOs' impact on science teaching practice in the classroom; and students' achievement of ILOs.

Again, experts were asked to deliver views about the condition that, comprehension of primary science teachers was somewhat on the approaches of primary science textbooks and teacher's edition to facilitate inquiry-based teaching-learning, besides there are some challenges like inappropriate professional development programs, the threat of time management, deficiency in inquiry-based instructional techniques and strategies, resources available at the schools: human and physical, classroom management, lack of collegial supervision, insufficient guides for connecting curriculum and inquiry teaching, lack of motivation, the practical constraints of the learning context. Expert A said,

Teachers plan their lessons following TB and TE. So, understanding of textbooks and teacher's edition approaches is vital for teaching learning. However, documents should be more clear and more understandable for all. Besides proper professional development training, the cooperation of other academicians, the institutional facilities also motivate to understand the document approaches. The situation of understanding of TB and TE affects science teaching learning.

Expert B said

The status of text books and teacher's addition may reflect on teachers understanding. So it is important to develop clear and understandable curriculum documents. It also reflected on concerned stakeholders understanding as they also get help from curriculum documents. Besides this, proper training, proper classroom and time management, resources etc. encourage them to understand and practice these approaches.

The statements reveal that the situation of understanding of textbooks and teacher's editions affects science teaching learning practice and students' achievement of ILOs.

Further, experts were asked to give opinions about the status of learning opportunities for inquiry-based teaching that did not practice in the science classroom, besides there are some challenges like perspectives on the meaning of inquiry-Based teaching-learning, the divergent perspectives of what constitutes appropriate guidance of inquiry, the threat of time management, deficiency in inquiry-based instructional techniques and strategies, in appropriate professional development programs, Commitment to inquiry, Classroom management, insufficient guides for connecting curriculum and inquiry teaching, lack of motivation, management of extended activities, the practical constraints of the learning context.

Experts A stated,

To implement inquiry, it is essential to understand the inquiry approach and its practice in the classroom; some specific learning opportunities have to provide sequentially. The findings of this study about classroom practice of inquiry, directly influence students learning and students' achievement of ILOs. With proper knowledge of the inquiry, some supports like collegial cooperation, resource materials, resource persons, institutes environment, proper training on curriculum documents and teaching strategies, etc., can motivate to practice inquiry in the science classroom.

The statements reveal that the situation of classroom practice of inquiry-based teaching affects students learning and achievement of ILOs.

Again, experts were asked to give opinions about the state that primary science teachers perceive somewhat about the practice assessment methods to achieve the ILOs, in addition to there are some challenges like inappropriate professional development programs, the difficulty of Assessment, insufficient guides for connecting curriculum and inquiry

teaching, lack of motivation, assessment of overcrowded classroom, classroom management, statistical analysis of assessment. Expert A said,

Assessment is the most important part of teaching-learning. The status of teachers' perception of assessment has a negative impact on the learning outcomes of students. Sufficient professional development training programs in curriculum and assessment can motivate in understanding and practice of assessment methods.

The statements reveal that, the state of perception on assessment methods can negatively impact students' achievement of ILOs.

Experts were asked to give views about the situation that primary science teachers perceive somewhat about the extent of students learning toward achieving the ILOs with some challenges, difficulty of Assessment, insufficient guides for connecting curriculum and inquiry teaching, lack of motivation. Expert A orated,

Assessment allows teachers to collect information about the student's progress as well as the extent to which the students achieve the intended learning outcomes. The situation of teachers' perception about the extent of students learning toward achieving the ILOs can hamper students' achievement levels. Proper training on curriculum instruction and assessment can help the teacher to develop their understanding of the extent of students' achievement.

The statements reveal that, the situation of perception on assessment methods can negatively impact students' level of ILO achievement.

Further, experts were asked to give their opinion about the existing situation of primary science teaching practice towards inquiry. Expert A alluded that,

Actually ILO, teaching learning, and assessment must align with each other, and one affects another. In this study's findings, it is seen that there is no alignment in ILO, teaching-learning activities, and assessment. teachers' understanding reflected in classroom practice. Concern stakeholders understanding may reflected in teachers' understanding. The status of provided information in curriculum documents may also reflected in concerned stakeholders and teachers' comprehension, and teachers' practice. This situation must hamper students' achievement of learning.

Expert B opined that,

Teaching-learning is an aligned process of three components where ILO, teaching-learning, and assessment are interconnected. The situation of this study's findings indicates that in primary science teaching practice, there is no alignment on ILO, teaching-learning practice, and assessment. This situation must prevent students' ILO achievement.

The statements of science education experts reveal that, there is no alignment in primary science teaching practice.

Furthermore, experts were asked to give their opinion about 'how does this situation of primary science teaching practice effects on developing curriculum documents?' Expert A opined that,

Teachers are the planner to implement curriculum intention in the classroom. They get support directly from curriculum documents and concerned stakeholders. Concerned stakeholders have been involved in teacher training, supervision, and monitoring. They also involve in developing curriculum documents: TB, TE, AG, and training manuals. The findings in this study shows that the existing comprehension of concerned stakeholders match with the existing condition of the curriculum documents. So, their understanding may be reflected in developing curriculum documents.

Expert B viewed that

Besides teachers' own understanding, they directly get help from textbooks and teacher's edition to conduct lessons. As well as concerned stakeholders are also involved in providing support by training, monitoring, and supervising, and the activities needed for teachers' professional development. They are involved in developing curriculum documents and training manuals also. So, concerned stakeholders' understanding can affect in developing curriculum development.

The statements of science education experts reveal that the existing status of concerned stakeholders' comprehension of the components of constructive alignment match the existing status of the curriculum documents. Therefore, concern stakeholders' comprehension can reflect on developing curriculum documents.

➤ Overall remarks

Alignment does not exist in the primary science teaching practice toward inquiry in Bangladesh. Concern stakeholders' comprehension can effect on developing curriculum

documents.

4.26 Summary of the Chapter

This chapter has explored the findings of this study. The findings are accumulated from the four cases in each research question (RQ), and the overall findings in each RQ are presented next,

The first RQ is about the comprehension of the focus of ILOs. The findings of the study indicate that teachers' comprehension was almost the same (Somewhat) regarding the focus of ILOs. Teachers' somewhat comprehension of ILO focus was somewhat reflected in classroom practice. Concern stakeholders expressed almost the same (Somewhat) about the focus of ILOs that may reflect in teachers' comprehension and classroom practice as they are engaged in teacher training, supervision, and monitoring. Curriculum documents (TB & TE) also provide somewhat information about the focus of ILOs.

The second RQ is about the comprehension of the approaches of TB and TE. The findings specify that teachers' comprehension was almost the same (Somewhat) regarding the approaches of TB and TE. Teachers' somewhat comprehension of the approaches of Tb and TE was somewhat reflected in classroom practice. Concern stakeholders expressed almost the same (Somewhat) about the approaches of TB and TE, which may reflect in teachers' comprehension and classroom practices. Mostly, the approaches are somewhat addressed in curriculum documents (TB&TE).

The third RQ is about the practiced opportunities of inquiry-based teaching. The findings reveal that teachers comprehend almost same about the inquiry-based teaching. They did not comprehend inquiry approaches. Teachers' comprehension was reflected in the classroom as teachers did not practice inquiry-based teaching in the science classroom. Concern stakeholders also did not comprehend the inquiry approaches that may reflect in teachers' comprehension and classroom practices. Mostly, curriculum documents (TB & TE) moderately addressed the inquiry approaches.

The fourth question is about the perception of assessment methods to achieve the ILOs. Teachers comprehend almost the same (somewhat) about the assessment methods.

Teachers' comprehension of assessment methods was somewhat reflected in teachers' practices of classroom and summative examination. Concern stakeholders also comprehend somewhat the assessment methods, which may reflect in teachers' comprehension and practices. Mostly the information on assessment methods is somewhat addressed in curriculum documents.

The fifth RQ is about the perception of the extent of students' achievement of ILOs. The findings explore that, teachers' perception was almost the same (somewhat) about the extent of students learning to achieve the ILOs. Teachers' perception was reflected in teachers' assessment practice. Concern stakeholders also have almost the same perception (somewhat) about students' achievement of ILOs, and their perception may reflect in teachers' perceptions and practices.

The sixth RQ is about the challenges of implementing inquiry-based teaching in the science classroom. This study specified some challenges that prevent teachers to implement inquiry in science classes.

The seventh RQ is about the effects of the existing status of constructive alignment on developing curriculum documents. The study explores that, in the primary science teaching practice of Bangladesh constructive alignment does not exist among the intended learning outcomes (ILOs), learning activities (LAs), and assessment (A). this situation can effects on developing curriculum documents. The next chapter presents a discussion of the findings.

Chapter Five: Discussion

This chapter summarizes the research findings in relation to the research questions and provides a critical discussion of the findings by linking the associated literature where applicable. The main purpose of this study is to explore the existing constructive alignment in primary science teaching practice towards inquiry and its effect on developing curriculum document. It has two main focuses: to explore the existing constructive alignment of the intended learning outcomes, learning activities, and assessment in primary science teaching practice towards inquiry; and to explore the effects of existing constructive alignment on developing curriculum document.

The central research question of the study is,

How does the situation of existing constructive alignment towards the inquiry approach effects the development of primary science curriculum documents?

The study is directed into seven research questions specifically which addressed the central question as a whole, these are:

1. How do primary science teachers comprehend the focus of intended learning outcomes in line with inquiry-based teaching-learning?
2. How do primary science teachers comprehend the approaches of primary science textbooks and teacher's editions to facilitate inquiry-based teaching-learning?
3. How learning opportunities of inquiry-based teaching are practiced in science classrooms?
4. How do primary science teachers perceive the practiced assessment methods to achieve the ILOs?
5. How do primary science teachers perceive the extent of students learning towards achieving the ILOs?
6. What challenges do primary science teachers face to practice inquiry in the science classroom?
7. What is the effect of existing alignments on developing curriculum documents?

The following sections in this chapter discussed the analysis of findings addressing two main focuses. The first focus is discussed under three categories: teachers' comprehension of ILOs, teachers' comprehension of teaching-learning activities towards inquiry, and teachers' comprehension of assessment. The second focus is to discuss the effects of existing constructive alignment on developing curriculum document.

5.1 Teachers' Comprehension about the Focus of ILOs

The findings of the study reveal that teachers of all four cases have somewhat comprehension of the focus of ILOs including the meaning of ILOs, the importance of ILO focus, and the identification of the focus of ILOs. According to Mahajan and Singh (2017), a proper understanding of ILO helps the teacher to develop quality teaching by planning a lesson, giving a clear idea of what and how much to teach, and planning accordingly, by designing their teaching material more effectively, by selecting appropriate strategies for teaching, by avoiding extra teaching which ultimately helps in saving time. Teachers' somewhat comprehension of the focus of ILOs may not help them develop a quality teaching plan which may lead them to conduct lessons without paying attention to ILOs.

Mahajan and Singh (2017) also added that the clear concept of learning outcomes helps teachers to make assessment mapping clear and easy; to measure the effectiveness of the unit, play a role in the allocation of marks in developing question papers, focus on the questions on what students should be learning and how they are going to teach this; to make evidences like rubrics, charts or graphs related to summative and formative assessment. Teachers' somewhat comprehension of the focus of ILOs may discourage them to assess students' ILO achievement and may encourage them to assess ongoing traditional methods without focusing ILOs.

Gronlund and Brookhart (2009) suggested that, the proper conception of teacher about ILO help them to identify knowledge, skills, and attitudes that students should develop through their course; to select and organize the lesson content, activities, and teaching-learning strategies that students will need for achieving the ILOs; to design assessment and feedback strategies that are aligned with the ILOs; to map their curricular outcomes for a program or accreditation standard. The findings of the study about teachers' somewhat

comprehension of the focus of ILO may not be helpful for the teacher to develop a teaching plan, conduct and assess the learners focusing ILOs; and may guide them to practice teaching-learning activities as a usual traditional way without focusing ILOs.

The results also indicate that teachers' comprehension of the focus of ILOs was reflected in teachers' lessons practice. Teachers did not comprehend the focus of ILOs and did not focus on it on the practice of the lessons. The concerned stakeholders of this study UEO, AUEO, and instructors of PTI and URC are directly involved in teachers' professional development through teacher training, supervision, and monitoring (DPE, 2012; MoPME, 2003). However, their training and backgrounds do not always make them qualified supervisors (Chowdhury, Samir, Chowdhury, & Ahmed, 2002). Therefore, concerned stakeholders' comprehension of the focus of ILOs may also be reflected in teachers' comprehension as they are engaged in teacher training, supervision, and monitoring. The somewhat provided information in curriculum documents may also be reflected in concerned stakeholders' comprehension and teachers' comprehension and lesson practice.

5.2 Teachers' Comprehension of Teaching-learning Activities Towards Inquiry

This section of the chapter discusses teachers' comprehension regarding the approaches of curriculum documents and regarding the employed learning opportunity for inquiry-based teaching.

5.2.1 Teacher's comprehension of the approaches of curriculum documents

The study reveals that teachers of the four cases in this study have somewhat comprehension of the approaches of textbooks and teacher's editions. The discussion followed nine key approaches identified in chapter two as the key aspects of primary science textbooks and teacher's editions. These key approaches are-

1. Starting lesson with a key question
2. Exploring prior knowledge
3. Real-life orientation of science concept
4. Science process skills

5. Activity-based class
6. Collaborative approach
7. Illustrations and diagram
8. Scope of inquiry-based teaching
9. Lesson summary

1. Starting lesson with a key question

Several kinds of literature have argued that starting lesson with a key question is helpful for students' effective learning. Such a way of starting a lesson can easily engage students in teaching-learning activities (Cheesman, 2005). In addition, it is stated at the beginning of primary science textbooks as a major feature that, the key question is highlighted as the core point of teaching-learning in each lesson (NCTB, 2020). In this study, teachers of all four cases did not comprehend the approach of starting lesson with a key question; which may not support students to engage in effective teaching-learning activities; and influence the teacher to start lesson without giving attention to the key question. Protheroe (2007) asserts from the study that, when a lesson starts by posing questions, it involves students to arouse their interest, and curiosity and engage them in a further investigation (Protheroe, 2007). According to Minstrell (2000), the scientific inquiry arises from curiosity, which naturally leads to questioning. Starting a lesson by posing question make the learning interesting and allow students to explore, explain, extend, and evaluate their progress (National Research Council, 2000). Starting lesson with a key question is one of the most critical phases of inquiry-based teaching-learning process and the teacher can provide a significant role to engage students in inquiry (McCann, 2016). Teachers of this study who did not comprehend the approach to starting lessons with a key question, may not make students interested and curious about science learning, which may not influence students to engage in inquiry-based learning.

McCann, Marek, and Falsarella (2016) asserted that, if students engage in questions to drive teaching and learning, students can find out their weak spots of thinking, and understanding becomes clear in a way that helps them to realize their limitations and begin to develop an understanding of what information is lacking and move forward to resolve the gaps of knowledge. Teachers having no comprehension of the approach to starting

lessons with a key question may not give students the opportunity to engage them in such teaching-learning activities that drive them to move forward to resolve the gaps of knowledge.

2. Exploring prior knowledge

Exploring students' prior knowledge can guide teachers to design appropriate teaching strategies; helps teachers to know a student's alternative conceptions and assist teachers to construct students' conceptual change (Posner & Gertzog, 1982). Fensham (1985) suggests that for a 'Science for All' curriculum teaching of science, concepts should 'begin as an extension of what the learners already know from their experience prior to schooling'.

Marzano (2004) and Schallert (2002) stated that exploring students' prior knowledge can guide teachers to design appropriate teaching strategies, assist students to connect past experiences and new incoming information, consequently enhance effective teaching-learning; and it is the strongest indicator of how well they will learn new information relative to the content. Teachers having somewhat comprehension of all four cases about exploring students' prior knowledge may not be able to design appropriate teaching strategies to enhance effective teaching-learning.

However, Sultana et al., (2019) found that teachers were aware of the importance of exploring students' prior knowledge and they practice it to conduct effective teaching. Moreover, Chin (2007), and Osborne and Freyberg (1985) found that teachers are facilitating to activate students' prior knowledge with Q-A before starting a new lesson. Teachers of this study, somewhat comprehend exploring students' prior knowledge and somewhat practice it in the science classroom; that can motivate them to conduct a traditional lesson.

3 Real-life orientation of science concept

Real-life orientation of science concepts helps students in developing and practicing a variety of life skills to adapt to the changing society through problem-solving, decision-making and taking appropriate action. According to Fernandez and Yoshida (2004) science classes should be related to children's experiences in the environment and daily life. Teachers of all four cases in this study have moderate comprehension of real-life

orientation of science concepts, and teachers with moderate comprehension can relate science concepts with students' daily life.

Jenkins et al. (2006) suggested from their study that, the real-life orientation of the science concept emphasizes the skills and values of students in real-life situations, participation in physical activity, community organizations, and initiatives. Sultana et al. (2019) found in their study that, teachers linking real-life situations with science concepts in their practiced lessons consider it as a very important matter for science teaching-learning. Teachers having moderate comprehension of this study may consider real-life orientation in science concepts to develop students' skills and values.

4. Science process skills

Helgeson (1992) indicated that the most effective approaches in teaching science are integrating science process skills and science content using hands-on activities which focus on specific problem-solving skills. Students can effectively learn science through conducting hands-on activities (Ostlund, 1992). Science process skills are considered one of the necessary tools to produce and use scientific information, perform scientific research, and solve problems. Students can be achieved science process skills through some specific scientific activities (Harlen, 2014; Huppert et al., 2002). Teachers of the four cases in this study did not comprehend science process skills, which may not support them to conduct classes through hands-on activities which help to achieve students' science process skills; and inspire teachers to conduct science classes in the usual traditional way.

Sultana et al. (2019) found in their research that, teachers were aware of the importance of science process skills but found only less than half of the participant teachers were well known about science process skills and practiced traditional teaching in the science classroom without focusing on science process skills. Teachers without an understanding of science process skills in this study, also conduct science classes without focusing on science process skills; which may hamper students' science learning.

According to Esler and Esler (2001), the modern elementary science curriculum emphasized two major goals: enabling children to develop science process skills and acquire appropriate science content. The reason for setting science process skills as a

curriculum goal is students emphasized the intellectual value and attitudes rather than the value of memorizing scientific facts or principles. Teachers did not comprehend science process skills; their comprehension may hinder the achievement of the major goal of the curriculum.

5 Activity-based learning

Haury and Rillero (1994) suggests that a child learns science best by doing science. Lakshmi (2013) found that activity-based teaching-learning encourages self-learning and it is learner-centered. Lakshmi (2013) also added the prerequisite for science learning should be based on doing experiments or activities. If a learner is provided the opportunity to think and solve the problems on their own then the learning becomes long-lasting and allows the learner to study according to his/her own ability and skills. However, Kaya and Akdemir (2016) found that teachers who are more aware of the instructional activities spent less time on teacher-centered activities and more time on student-centered activities. Kaya and Akdemir (2016) also added, when teachers lacked the necessary knowledge base about student-centered, time management, and inquiry activities, they might have problems implementing these types of science activities in their classrooms. Teachers of Case A and Case C had somewhat comprehension, and teachers of Case B and case D did not comprehend the activity-based class. Teachers' comprehension may not assist them to conduct a learner-centered activity-based class for science learning and may encourage them to conduct the class traditional manner rather than following instructions for doing activities.

6 Collaborative approach

Wismath et al. (2015) stated, collaborative approach is essential to develop students' 21st Skills. Griffin et al. (2015) suggests considering the collaborative approach as an essential tool when dealing with complex problems. According to Vygotsky (1978), students learn well when they work collaboratively rather than individually work. Rosaen et al. (2010) mentioned that the collaborative approach includes some indicator like developing argumentation, encouraging participation, guiding the discussion, and asking supportive questions that helps teacher provide opportunities for scientific discussion among students. Teachers of all four cases in this study have somewhat comprehension of the collaborative

approach. Somewhat comprehension of teachers, may not help them to engage students in a collaborative approach-based science class where students learn best collaboratively rather than individually.

7 Illustrations (picture and photograph)

Bishop's (1989) views that proper and relevant illustrations such as pictures or diagrams play a strong role as a tool for students learning and it helps students to understand the concepts and make them interested. by using appropriate diagrams students can interact properly with science concepts (Thomas & Hong, 2001). Teachers of the four cases of this study have somewhat comprehension about illustrations; their somewhat comprehension may not support them to make science concepts easy to understand for the students by using related illustrations, picture and photographs; and this can encourage them to conduct class without focusing illustrations.

8 Lesson Summary

Van Dijk and Kintsc (1983) study that lesson summary has an effect on student understanding of lesson content. Haystead and Marzano (2009) view that lesson summary helps to increase students' understanding of content. Teachers of the four cases in this study have somewhat comprehension of the lesson summary; that may not assist them to focus on the lesson summary for students' better understanding during conducting the lesson.

5.2.2 Teachers' Comprehension of the employed learning opportunity for inquiry-based teaching

Inquiry-based teaching is an approach to teaching. Avsec and Kocijancic (2014) stated that inquiry-based teaching has an effective teaching approach in education. Conner (2015) indicate that the proper understanding of inquiry-based teaching support teacher to be more effective in planning, teaching, and learning process. The findings of the study indicated that teachers' unawareness of inquiry-based teaching misguided them to prepare a good plan for the classroom; which may motivate them to practice traditional teaching-learning activities.

The study reveals that teachers of four cases did not comprehend inquiry and did not practice inquiry-based teaching in science classrooms. Driver (2011) and Isaac and Clara (2019) found that teachers who practice inquiry-based teaching in the classroom, improve teaching and students' achievement of learning outcomes (ILOs). Spronken and Walker (2010) also argued that inquiry-based teaching is useful to achieve ILOs. Teachers did not comprehend inquiry-based teaching which may prevent teachers to improve their teaching and students' achievement of ILOs, and that may influence them to hardly practice or not practice inquiry-based teaching in science classrooms. This finding is also consistent with the findings of Ababio and Dumba (2014), who found that teachers were not practicing inquiry-based teaching because they did not have the expertise regarding inquiry-based teaching

Subba et al. (2019) conclude their study that inquiry-based teaching has an important effect on students' achievements of ILOs as it helps to enhance students' interests, positive attitudes, and achievement in science. They further added that inquiry-based teaching can provide learning opportunities that help students learn to investigate, construct assertions and justify those assertions in the classroom community. Similarly, Williams et al. (1998) found that inquiry-based teaching can help gain greater conceptual understanding in science. Moreover, Saunders-Stewart et al. (2015) concluded that inquiry-based teaching provides opportunities for students to develop knowledge and skill, increased intrinsic motivation, development of expertise, self-efficacy, task commitment, positive attitudes about learning, competence or expertise, and greater creativity. The findings of the study reveal that teachers of the four cases did not comprehend inquiry-based teaching; which may lead them to not practice inquiry-based teaching in science classrooms. As a result, students may not be able to achieve the ILOs and may lose their interest, attitude, understanding, and achievement in science.

Inquiry teaching refers to the activities of students in which they develop knowledge and understanding of scientific ideas and also develop an understanding of how scientists study the natural world (NRC, 1996). Scientific inquiry involves the combining of traditional science processes with scientific knowledge, scientific reasoning, and critical thinking to develop scientific knowledge as well as the development of science process skills,

attitudes, and values (Dawson & Venville, 2010). Therefore, adequate knowledge of inquiry-based teaching developed students' science process skills, attitudes, and values as well as critical thinking for scientific inquiry. The findings of the study indicated that teachers did not comprehend inquiry-based teaching, which lead them not to motivate students toward scientific knowledge through practicing inquiry in the science classroom.

It is found from the study of Kuhlthau et al. (2007), Littky and Grabelle (2004), and Wiggins and McTighe (2001) that inquiry teaching provides opportunities for students to focus on learning through questioning and reflection skills. The teachers of the study did not comprehend inquiry-based teaching which lead them not to give learning opportunities to the students for inquiry in the science classroom; which may hinder students understanding of science.

The study by Kuhlthau et al. (2007), and Littky and Grabelle (2004) settled their study that, inquiry teaching provides inquiry skills that are aligned with methods of learning, which have been referred to as problem-based learning, authentic learning experiences, investigative processes, learning through lenses, critical thinking. Buchanan, et al. (2016) determined from the study that, inquiry-based teaching allows teachers to make students determine about problems, about the challenges and issues they investigate, and helps to move the students into a more meaningful engagement and deeper learning. Cooper and Murphy (2016) suggested from their study that, an adequate understanding of the teacher must provide a classroom that rests upon positive connections between the teacher and the student, positive relationships between peers, ample time for students to speak with one another, and a classroom that fosters empathy to engage students in effective inquiry. Liu and Smith (1998) found that IBL can help gain a greater conceptual understanding of science. The findings of the study that teachers did not comprehend inquiry-based teaching, may not help the students to get these opportunities of inquiry-based teaching found from different studies.

5.3 Teachers' Perception of the Practiced Assessment Methods to Achieve the ILOs

The findings indicated that teachers of the four cases in this study have somewhat comprehension of assessment methods. The earlier research suggests that assessment helps teachers to improve the quality of learning and teaching in classrooms and helps to achieve the ILOs (Biggs, 2003; Hargraves, 2007; Irons, 2008; Jones, 2005). Teachers' somewhat comprehension may not support them to improve the quality of teaching and learning; and may inspire them to practice as usual traditional assessment methods in the classroom without giving their attention to whether the intended learning outcome is achieved or not after the completion of a lesson.

Harlen (2014) suggests from his study that when teachers practice assessment unconsciously, without a deep understanding of its meaning or purpose, it could have negative impacts on students' achievement of ILOs. The somewhat comprehension of the teachers may impact negatively students' achievement of ILOs, and that may guide them to give less emphasis on assessing learning outcomes and doing on-going assessment.

Hussain et al. (2019) found that the majority of teachers carried out assessment practices without understanding these practices properly which negatively influence students' achievement and teachers' performances. The findings of teachers' somewhat comprehension of assessment may influence students' achievement and teachers' performances and motivate them to practice ongoing traditional assessment methods while being unaware of whether the intended learning outcome is achieved or not.

LaMarca (2001) found that assessments must allow students to demonstrate their knowledge, skills, and attitude in accordance with the curriculum intention so that their performance could be clearly interpreted. Broadfoot and Black (2004), and Ellis (2004) found in their study that, traditional assessment negatively affects teaching and learning. The somewhat comprehension of the teachers in this study, may not give students the opportunity to achieve in line with the curriculum expectations; and may allow them to practice traditional ongoing assessment which negatively affects teaching and learning.

Classroom assessment practices are the most important aspect of classroom instruction. Gronlund (2006) found in his research on educational assessment that, traditional assessment practices need less time and low-level thinking of students which has less impact on students' academic achievement. The teachers of this study somewhat comprehended both formative and summative assessment methods. Teachers assess students in the classroom during lesson conduction as formative assessment. Their somewhat comprehension of assessment methods and the needed less time may instruct them to follow traditional assessment systems without giving attention to ILOs, so students thinking low level and that may impact students' academic achievement.

According to Ainscow (1988) and Popham (1999) formative assessment is found as a vital component for effective teaching and learning and it helps to select any planned method or strategy used in the classroom to identify students' difficulties or understanding of a particular concept or idea and to solve it for students effective learning. Many scholars confirm that formative assessment is a typical benchmark of the teaching and learning process which enhances the learning process (Stiggins, 1992; Black & William, 1998). They also give evidence that significant learning can be achieved when formative assessment is incorporated into classroom practices. Stiggins and Chappuis (2006) suggested from their research that, assessment has a powerful influence on learning outcomes; so, integration of assessment with teaching and learning is essential for effective teaching-learning. Teachers' somewhat comprehension of formative assessment and the extent of students' ILO achievement in this study, may influence teachers' formative assessment planning; and this can affect students' achievement of ILOs.

William and Tompson (2007), Scriven (1967), Bloom (1969) suggested from their study that, teachers evaluate and make important judgments about learners' achievements at certain relevant points in the learning process (e.g. end of course, project, semester, unit, and year) for effective teaching program through summative assessment. Elkader (2008) found that teachers' assessment practices are directly related to instruction, student learning, and achievement of ILOs. Teachers are expected to be knowledgeable about assessment methods and able to use assessment knowledge for ensuring students' achievement level that to what extent students achieve ILOs (Bookhart, 2001; Cambell &

Evans, 2006). Teachers' somewhat comprehension of assessment methods and students' achievement level of ILOs, can hamper the effectiveness of teaching programs and students' achievement level of ILOs.

5.4 Challenges of Practicing Inquiry in the Science Classroom

As a teaching method despite its numerous benefits, an inquiry has some obstructions which always limit its practice. International studies indicate that teachers are challenged to implement inquiry-based teaching-learning in a science classroom (Gallagher, 1989; Edelson et al., 1999). This study finds some significant challenges to the successful implementation of inquiry-based teaching in the classroom, which is discussed next.

1. Perspectives on the meaning of inquiry-Based teaching instruction

The meaning and interpretation of inquiry-based teaching-learning are a major concern that which activities do, and which do not constitute inquiry. However, teachers of all four cases did not comprehend inquiry-based teaching; and had different perceptions of what inquiry-based teaching-learning entails. Bell et al. (2005) view that if the students are not involved in the analysis of data to generate the answer to the question, the activity may be simply referred to as a hands-on activity rather inquiry. However, teacher guidance and support for optimal learning gain are also dependent on teachers' understanding. Teacher knowledge and understanding of inquiry-based learning provide direction and motivation to students to conduct scientific investigations (Connor et al., 2016; Østergaard, 2016). The different comprehension of the meaning of inquiry-based teaching may create problems to implement inquiry in the science classroom and students' achievement of ILO.

2. The divergent perspectives of what constitutes appropriate guidance of inquiry

The most rational level of appropriate guidance must reflect in the inquiry process with a balance between learners and teachers, and the level of guidance and support depend on who is responsible for the inquiry activity. The instructor who becomes a facilitator in inquiry teaching may provide vital kick-starter guidance on a minimal scale that is appropriate to learners (Blanchard, Southerland, Osborne, Sampson, Annetta & Granger, 2010). The different perspectives of what constitutes appropriate guidance of inquiry may inspire to avoidance of inquiry-based classes in the science classroom.

3. The threat of time management

Costenson and Lawson (1986) view that teachers do not prefer inquiry-based methods as time is needed for an inquiry-based science lesson preparation for learners' meaningful exploration and discussion in class. Loughran (1994) also stated time management is a constraint for inquiry teaching. Time management is a vital issue for the teachers to not practice inquiry in this study. Teachers with such types of perceptions may hamper the practice of inquiry in the science classroom.

4. Deficiency in inquiry-based instructional techniques and strategies

Capps and Crawford (2013) mentioned that teachers having lack of understanding inquiry-based learning will have little to no interest in conducting the inquiry approach in their classrooms. This type of teacher will skip the inquiry approach in the classroom. Somewhat comprehension of inquiry may not help to provide inquiry-based instructional techniques and strategies and inspire to skip the inquiry learning approach.

5. Inappropriate professional development programs

Research has shown that short-term training of teachers on inquiry instruction did not changes teachers' practice (Yoon et al., 2007). Teachers with great knowledge and competence are an asset and leave a positive impact on the student's accomplishments (Harlen, 2014). Therefore, for sustainability professional development programs should be an all-year-round program, with monthly regular workshops, weekly meetings, and daily co-teaching followed by interrogation. It will take establishing and promoting collaborations among teachers with the support of the administration. Teachers having inappropriate professional development programs may not support teachers to understand the inquiry approach and practice it in the science classroom.

6. Commitment to inquiry

The commitment of stakeholders to work towards the implementation of inquiry-based learning as an approach to science learning. Good teachers of science allow students to follow their interests and try to find answers to questions posed by themselves in implementing inquiry-based learning (Gatt & Zammit, 2019). Somewhat comprehension of inquiry teaching may encourage to be not committed to inquiry-based teaching.

7. Resources available at the schools: Human and physical

Walker (2007) stated lack of resources is one of the problems that might hamper the interest in inquiry-based teaching by teachers. Teachers of this study prefer the traditional direct teaching method as they do not have enough support for innovative pedagogies. Physical resources play a supportive role as they allow teachers to improve the lesson by taking part in practical experiments using the proper tools and equipment (Wellcome Trust, 2015). Besides this, teachers need the necessary equipment in a required quantity; classroom and lab facilities; access to outside space; and ICT and technical support to implement inquiry successfully. Teachers having a lack of resources may not boost their confidence and self-efficacy.

8. Difficulty of Assessment

Dixon and Worrell (2016) asserted that two types of assessment complement each other although they have different purposes. Literature suggests that assessment helps to improve teachers' quality of teaching in classrooms, and helps to achieve students' ILO (Biggs, 2003; Hargraves, 2007; Irons, 2008 and Jones, 2005). Summative assessment may not be helpful for inquiry-based learning as inquiry skills need direct observation to assess. However, Jonathan's (2012) study indicated that inquiry-based learning requires more formative forms of assessment. Gronlund's (2006) study on educational assessment revealed that traditional assessment practices need less time and low-level thinking of students which has less impact on student's achievement. Somewhat comprehension of assessment may not be helpful for inquiry-based learning, and that guides to practice of traditional assessment methods without giving attention to students' achievement of ILOs.

9. Classroom management

Crystal (2012) found in the study that teachers faced challenges to monitor students' behavior and keeping them on task, especially in larger classes. Teachers of large class sizes faced the challenge and maybe demotivated to practice inquiry in the science classroom.

10. lack of collegial supervision

Senior teachers could provide experiential suggestions to others with their teaching experiences, content and pedagogical knowledge (Brickhouse & Bodner, 1992). School authorities can arrange formal and informal learning communities for teachers to exchange teaching ideas. Teachers need support from other teachers to share and solve different aspects of teaching-learning (Darling-Hammond & Baratz-Snowden, 2005). lack of collegial supervision is mentioned as an obstacle to practice inquiry.

11. Insufficient guides for connecting curriculum and inquiry teaching

Adam and Krockover (1997) found in their study that, when teachers are able to connect the curriculum instruction with inquiry-based teaching, they become more confident to do inquiry. Somewhat comprehension of curriculum documents may prevent connecting curriculum instruction with inquiry and encourage to conduct of traditional classes.

12. Lack of motivation

Teachers having less understanding of inquiry-based teaching, lose their interest to introduce inquiry in science classrooms (Capps & Crawford, 2013). Inquiry requires a higher level of motivation for both teachers and students; due to a lack of sufficient motivation, they lose their interest to participate or participate in a disengaged way (Edelson, Gordin, & Pea, 1999). Soloway et al. (1994) recognized motivation as a prime challenge for Learner-Centered teaching. Lack of sufficient motivation may discourage teachers to practice inquiry.

13. Accessibility of investigating techniques

The scientific inquiry needs a level of accuracy and care that are needed for students' science learning (Edelson et al., 1999). Soloway et al. (1994) reported that tools needed for inquiry must be accessible to learners and align with their abilities and prior experiences. Mostly, concerned stakeholders and teachers need easy access to tools and techniques for investigation.

14. Management of extended activities

Students are not naturally asked to manage extended complex processes as part of their traditional learning activities (Edelson et al., 1999). They added that, if they are unable to

organize activities and manage an extended process whenever necessary, students cannot engage in open-ended inquiry and cannot achieve the goal of inquiry-based learning. Teachers and concerned stakeholders claimed that activities in science classes need management skills whenever need to conduct the activity, otherwise, it makes problems for them.

15. The practical constraints of the learning context

The technologies and activities of inquiry-based learning must be suitable for the practical obstacle of the learning environment like available resources and fixed schedules (Edelson. Et al., 1999). Teachers faced practical constraints in the learning context to do inquiry and this is a vital challenge for inquiry practice.

5.5 Existing Constructive Alignment in Primary Science Teaching Practice and its Effect on the Developing Curriculum Document

Several research has been conducted regarding approaches, strategies, and techniques for enhancing teaching, learning, and assessment (Biggs, 2003; Conrad et al., 2007; Livingstone, 2014; Loyens & Gijbels, 2008; Slavin, 2011; Wiggins, 2015) and an integrative concept of constructive alignment has been proposed by Biggs and Tang (2007) where intended learning outcome, teaching-learning activities, and assessment are aligned. It is important to ensure that the curriculum, assessment, and instruction in the science program are aligned, as the research literature indicated that constructive alignment enhances learning outcomes (Biggs, 2009). In the primary science teaching practice of Bangladesh, teachers' somewhat comprehension was reflected in teachers' lessons practice. Concerned stakeholders' somewhat comprehension may be reflected in teachers' comprehension as they are engaged in teacher training, supervision, monitoring and manual writing, and many other activities for teachers' professional development. The moderately provided information in curriculum documents may also be reflected in concerned stakeholders' comprehension and teachers' comprehension and lesson practice. In the primary science teaching practice of Bangladesh, constructive alignment does not exist among the intended learning outcomes, teaching-learning activities, and assessment; this may not enhance students' achievement of learning outcomes.

John Biggs (2001) also argued that effective teaching-learning requires a careful alignment of intended learning outcomes, learning activities, and assessment. Therefore, the alignment status of Bangladesh may not be helpful for effective teaching and learning and affect students' achievement. Constructively aligned learning is likely to be more effective than unaligned because there is maximum consistency throughout the system (Biggs & Tang, 2011). The existing constructive alignment status of primary science teaching practice towards inquiry may not create an effective learning environment, and hamper the education system of its unaligned condition.

Saeed and Rashid (2014) summarized in their study that, curriculum documents are developed in such a way that they are aligned with the textbook content presentation; otherwise, it is hard to attain the national aims to an expected extent and the whole education system of a country is severely affected. Curriculum document developers are responsible to maintain the alignment. Concern stakeholders are engaged in training, supervision, and monitoring of the teachers. As well as they are engaged in different activities needed for teachers' professional development like curriculum document development, training manual writing, etc. The existing status of concerned stakeholders' comprehension of the components of constructive alignment matches the existing status of the curriculum documents, and their comprehension may effect on developing curriculum documents.

Chapter Six: Implications

This chapter discusses the implications of the research findings from this study. It has been found from the findings that mostly teachers have somewhat comprehension of ILOs, teaching-learning activities, and assessment methods. It is also found from the study that the comprehension of supporting human resources, and the addressed supporting materials may be reflected in teachers' comprehension. These results then ultimately carry implications for primary science teaching practices and curriculum document development in Bangladesh. This chapter presents several implications based on the finding into three categories: knowledge, practice, and policy.

6.1 Implications for Knowledge Gap

The research findings have an implication in the knowledge that is useful to almost all stakeholders. Moreover, researchers, policymakers, curriculum developers, and curriculum document developers may benefit from this knowledge. The research findings of this study revealed that in the primary science teaching practice of Bangladesh, constructive alignment does not exist. The findings also revealed that stakeholders' comprehension may effect on developing curriculum documents.

- ***Implications for the researcher:*** The provided knowledge can fill the void of existing knowledge which can help add to the literature about practices that work or advance better practices that educators might try in their educational settings. The researcher can use the knowledge of the findings of the study to confirm or disconfirm the results of prior studies that were done discretely regarding primary science curriculum intention, practice, and assessment. Previous research found that the existing primary science curriculum does not promote scientific literacy (Khan et al., 2016; Siddique, 2014; Rahman, 2015). The knowledge of the findings of this study regarding the existing status of the primary science teaching practice of Bangladesh may provide a clear scenario in the literature for further research.
- ***Implications for the policymakers:*** The knowledge of the existing status of constructive alignment in primary science teaching practice and its effect on developing curriculum documents may help policymakers and science educators to

take necessary steps at the policy level for an effective, better, and quality education system through a constructively aligned curriculum.

- ***Implications for the curriculum developers and curriculum document developers:*** The findings revealed that teachers and concerned stakeholders have somewhat comprehension of ILOs, LAs, and As. The findings also revealed that mostly curriculum documents (TB, TE, and AG) addressed somewhat regarding ILOs, LAs, And As. The curriculum developers and curriculum document developers can use this knowledge of the findings to develop or revise constructively aligned curriculum and curriculum documents.

6.2 Implications for Policy

Curriculum analysis and review is one key to improving the quality of education as it sets the ground for further development in the future by analyzing the current situation (National Council for Curriculum and Assessment [NCCA], 2005). In the education system, educators, policymakers, and curriculum developers are directly involved to design educational interventions for the purpose of improving the teaching and learning of a country. The research findings of this study revealed that constructive alignment does not exist in primary science teaching practice toward inquiry. The findings also revealed that stakeholders' comprehension may effect on developing curriculum documents. In Bangladesh, the findings of the study can be considered by policymakers, NCTB, and NAPE to evaluate the different aspects of the education system and to make changes for improvement accordingly. These changes bring the education system into closer alignment so that its parts function in parallel toward their common goal.

- ***Implications for MoPME:*** The overall responsibility of the management of primary education lies with the Ministry of Primary and Mass Education (MoPME), and MOPME is involved in the formulation of policies The objectives of primary education mentioned in education policy are- primary education is the basis of building up a skilled citizenry and the path to include the whole population within the education system (Education policy, 2010). Policymakers may take necessary steps in many aspects of the education system to have skilled citizens further which are mentioned in education policy by considering the existing status

of constructive alignment in primary science teaching practice towards inquiry and its effects on developing curriculum documents. Education policy is also mentioned to ensure quality primary education. The findings may help to maintain a quality primary education through a properly aligned education system.

- ***Policy for school authority:*** The main responsibility of supervising within the school rests with the Head Teachers. Therefore, policymakers can take necessary steps for the school authority so that they can arrange special training for teachers to discharge their duties skillfully. The policymakers may consider the findings of the study in this regard as the study revealed that constructive alignment does not exist in primary science teaching practice toward inquiry. The study also revealed that mostly, teachers have somewhat comprehension of ILOs, LAs, and As.
- ***Implications for DPE:*** Directorate of Primary Education is responsible for training primary school teachers in various training institutions operated by the directorate. DPE can take necessary steps to train primary teachers and concerned stakeholders through community practice sharing. Therefore, the necessary policy for DPE guides them to implement the necessary training. Policymakers can follow the research findings of constructive alignment of primary science teaching practice towards inquiry where the study revealed that teachers and concerned stakeholders have somewhat comprehension of ILOs, LAs, and As.
- ***Implications for NCTB:*** Education policy is addressed NCTB as an authority to develop educational materials: curriculum, curriculum documents, etc. By considering the findings of the existing status of the constructive alignment in ILOs, LAs and A, and its effect on developing curriculum documents, policymakers can take necessary steps for developing a constructively aligned curriculum and curriculum documents and other educational materials through NCTB accordingly.
- ***Implications for NAPE:*** Education policy is mentioned NAPE as a top national institute for the development of primary education through innovating new methods of teaching-learning for better and quality primary education. Policymakers can take necessary steps for NAPE to innovate and develop new methods considering the alignment of ILOs, LAs, and As.

6.3 Implications for Practice

In Bangladesh DPE, NCTB, NAPE, PTI, URC, and school authorities all these institutions are highly involved in teacher training, motivational programs design, and implementation for teachers' professional development after revising a curriculum. The findings revealed that in the primary science teaching practice of Bangladesh, constructive alignment does not exist among curriculum intention, classroom practice, and assessment. The findings also revealed that stakeholders' comprehension may effect on developing curriculum documents. The research findings suggest implications at the practice level where educators, teachers, and learners may benefit. Moreover, DPE, NAPE, PTI, URC, and school authorities may also use these findings in practice. All these institutions can be addressed or used the finding of the study to design and implement training programs and other programs related to teachers' professional development emphasizing the alignment.

- ***Implications for educators:*** The research findings of this study revealed that constructive alignment does not exist in primary science teaching practice toward inquiry. The findings also revealed that stakeholders' comprehension may effect on developing curriculum documents. These findings help the practicing educator to build connections with other educators who are trying out similar ideas in different locations. The findings of this study may also help educators to become more effective professionals and this effectiveness may translate into better learning for learners.
- ***Implications for the researchers:*** The researcher can use the methodology of the findings for further study to investigate constructive alignment in educational settings, or to confirm or disconfirm their research findings.
- ***Implications for DPE:*** Directorate of Primary Education is responsible for the administration of primary schools in Bangladesh. It is also responsible for the management and supervision of primary education. Specifically, it is accountable for the in-service training of teachers in various training institutions operated by the directorate (Education Policy, 2010). DPE can take the necessary steps through training for concerned stakeholders as the findings revealed that primary science teachers and their supporting human resources have somewhat comprehension of

ILOs, LAs, and As. The findings also revealed that stakeholders' comprehension may effect on developing curriculum documents. Therefore, effective and proper training needs to be organized for stakeholders, and DPE may consider the findings of constructive alignment of primary science teaching practice toward inquiry in this regard.

- ***Implications for NCTB:*** NCTB is addressed as an authority to develop educational materials: curriculum, and curriculum documents: subject-based textbooks, supplementary text materials, exercise books, and teaching aids (Books with analysis, exercise, and examples) in the light of the set objectives of the primary education (Education policy, 2010). The textbooks are being written in accordance with the guidelines of the curriculum and syllabus. So, the importance of the curriculum and syllabus design, and textbooks is immense. The findings of the existing status of the constructive alignment in ILOs, LAs, and As, and its effect on developing curriculum documents, can help NCTB to take necessary steps for developing a constructively aligned curriculum and curriculum documents, and other educational materials accordingly, as the findings revealed that mostly curriculum documents somewhat addressed the information of ILOs, LAs, and As. The findings also revealed that teachers and supporting stakeholders have somewhat comprehension of curriculum and curriculum documents. NCTB informs teachers about new or revised curriculum ideas, documents, or materials so that they understand and accept the innovation through curriculum dissemination. Therefore, NCTB can take the required steps through curriculum dissemination.
- ***Implications for NAPE:*** NAPE is mentioned as a top national institute for the development of primary education through innovating new methods of teaching-learning for better and quality primary education (Education policy, 2010). The findings of existing constructive alignment in primary science teaching practice towards inquiry may help NAPE to innovate and develop new methods considering the alignment of ILOs, LAs, and As, as the findings revealed that teachers and concerned stakeholders have somewhat comprehension of ILOs, LAs and As, and curriculum documents somewhat addressed the information of ILOs, LAs and As.

However, NAPE also arranges some necessary measures, like training the academic staff of PTIs and other field officials; preparation and approval of syllabus for basic teachers' teaching, supervision of training, conducting the exams of the trainees and conferral of diploma and initiation of appropriate research activities for the development of primary education, conducting of seminars and workshops (Education policy, 2010). All these activities need to follow the intention, implementation, and attainment of a properly aligned curriculum as the findings revealed that constructive alignment does not exist in primary science teaching practice in Bangladesh. Therefore, NAPE can take the necessary steps in this regard.

- ***Implications for PTI:*** PTI is assigned for primary teachers' professional development including teachers' training and supervision. Especially, the PTI instructor provides pedagogical suggestions to teachers in the classroom. They observe the classroom performance of trainee teachers and identify the level of achievement and provide supportive feedback to trainee teachers (DPE, 2012). Sometimes they also act as a mentor to qualify trainee teachers to achieve the expected level of performance (DPE, 2012). Therefore, PTI instructors may take into account the findings of the study for their professional development as the findings revealed that the concerned stakeholders who are engaged in teachers' training, monitoring, and supervision have somewhat comprehension regarding ILOs, LAs, and As.
- ***Implications for URC:*** URC very often provides academic services to primary schools at the local level and assists teachers to improve their teaching and learning (MoPME, 2003). At the same time, URC also attends meetings, and workshops and acts following the instruction of higher authority. Therefore, URC may consider the findings of the study for URC instructors' professional development as the findings revealed that the concerned stakeholders who are engaged in teachers' training, monitoring, and supervision, have somewhat comprehension regarding ILOs, LAs, and As. URC can also follow the findings when planning and conducting training sessions and develop a training manual for primary teachers' professional development. As a result, teachers could benefit from training programs that offer

the opportunity to develop the knowledge and skills needed for effective teaching and learning.

- ***Implications for school UEO and AUEO:*** UEO's and AUEO's have had actual classroom experience as they visit school directly, but their training and backgrounds do not always make them qualified supervisors (Chowdhury et al., 2002). The AUEOs play a leading role in providing professional support to primary school teachers (Education watch, 2003/4). Therefore, authority can take into account the findings of the study for the professional development of UEO and AUEO as the study explored that stakeholders' comprehension may effect on developing curriculum documents.
- ***Implications for school authority:*** Teachers' instructional decisions are directly influenced by professional development workshops (Moss, 2003). Therefore, the school authority can take necessary steps for teachers' professional development by providing them the opportunity for proper training and proper classroom practice, as the findings revealed that teachers have somewhat comprehension of ILOs, LAs and A.

6.4 Implications for Further Research

A number of limitations were identified and addressed in the course of this study considering the research design. These are discussed next.

- ***Limitations of the study***

This study aimed to provide a complete empirical document on the constructive alignment of curriculum intention, practice, and assessment in primary science classroom teaching practice toward inquiry of Bangladesh, as literature confirmed that some research has been conducted on primary science curriculum intention, practice, and assessment in a discrete way (Khan et al., 2016; Rahman, 2015; Siddique, 2014). The focus of this research has been directed at four primary school science teachers of different contexts (two rural and two urban) in Bangladesh through case study research. However, there is a large number of primary schools in Bangladesh including govt. and non-govt schools.

The diversity of schools was not fully represented in this study. The study mainly focused on teachers, their perception of teaching-learning, and the culture of their professional practice in primary schools of Bangladesh. The study considered four govt. primary schools from rural and urban areas of Bangladesh through case study research. But there are a large number of govt. and non-govt. primary schools. However, there is geographical diversity in Bangladesh where primary schools are situated in different regions. Therefore, research can be done to address the schools of different contexts of Bangladesh to know the regional diversity exists or not regarding the constructive alignment of primary science teaching practice towards inquiry in Bangladesh.

The findings of the study highlighted a number of emerging issues and areas of research that can be done further in large-scale or in-depth research separately. These are:

- Study the comprehension of the primary science teachers of ILOs or LAs, or As.
- Study the comprehension of the concerned stakeholders of ILOs or LAs, or As, who are engaged in primary science teachers' professional development.
- Study the effect of the existing constructive alignment of primary science teaching practice on developing curriculum documents.
- Study the challenges of inquiry science teaching practice faced by primary science teachers

Finally, the findings suggested repeating this study in both developing and developed countries to know the existing alignment status in education.

Chapter Seven: Conclusion

This chapter will conclude the study by summarizing the key research findings in relation to the research objectives. This chapter readdressing the research purposes, research questions, methods, and findings before making some concluding remarks.

7.1 Representing the Research Purpose and Questions

The purpose of this study is to explore the constructive alignment of intended learning outcomes, learning activities, and assessment in primary science teaching practice toward inquiry. The study also explores the effects of existing constructive alignment in developing curriculum documents. To explore the purposes, this research therefore focused on one central question which was posed with a number of sub-questions. The central research question provides the framework on which the conclusion of this study is based, and the question is concerned with the effect of existing constructive alignment on the development of primary science curriculum documents towards the inquiry. Among the sun questions, the first one was concerned with primary science teachers' comprehension of the focus of intended learning outcomes in line with inquiry-based teaching-learning. The second question concerned primary science teachers' comprehension of the approaches of primary science textbooks and teachers' editions to facilitate inquiry-based teaching-learning. The third one considered the practiced learning opportunities of inquiry-based teaching in the science classroom. The fourth research question focused on primary science teachers' perception of the practiced assessment methods to achieve the intended learning outcomes. The fifth one considered primary science teachers' perception of the extent of students learning toward achieving the intended learning outcomes. The sixth research question is concerned with the challenges faced by primary science teachers to practice inquiry in the science classroom. The seventh one considered the effect of existing alignments on developing curriculum documents.

To address these questions, the study used a multiple-case study approach within qualitative research. The study considered a social constructivist approach for conducting the research that deals with stakeholders' perspectives and practices in their real context.

7.2 Answers to the Research Questions

Research question 1: How do primary science teachers comprehend the focus of intended learning outcomes in line with inquiry-based teaching?

In response to the first research question, the study explored primary science teachers' comprehension of the focus of ILOs. The findings indicated that teachers of all four cases were somewhat comprehend about the focus of ILOs. In all four cases, teachers' comprehension was almost the same (Somewhat comprehend) about the focus of ILOs including the meaning of ILOs, the importance of ILOs, and the way of identifying ILO focus. Teachers' somewhat comprehension of ILO focus was somewhat reflected in classroom practice. Concern stakeholders of four cases expressed almost the same (Somewhat comprehension) about the focus of ILOs that may reflect in teachers' comprehension as they are engaged in teacher training, supervision, and monitoring. The textbook (TB) did not mention ILOs, and the teacher's edition (TE) mentioned ILO but did not address ILO focus.

Research question 2: How do primary science teachers comprehend the approaches of primary science textbooks and teacher's editions to facilitate inquiry-based teaching?

The study aimed to explore teachers' comprehension of the approaches of textbooks and teacher's editions. The findings showed that teachers have somewhat comprehension of the approaches of textbooks and teacher's editions. In all four cases, teachers' comprehension was almost the same (somewhat comprehend) regarding the approaches of TB and TE. Teachers were the same in the classroom practice. Teachers somewhat comprehension of the approaches of TB and TE was somewhat reflected in classroom practice. In all four cases, concerned stakeholders have the same comprehension (somewhat comprehend) about the approaches of TB and TE. Their comprehension may be reflected in teachers' comprehension. Mostly, curriculum documents (TB & TE) somewhat addressed the identified approaches.

Research question 3: How learning opportunities of inquiry-based teaching are practiced in the science classroom?

The study planned to explore the opportunities of inquiry-based teaching-learning practice.

The findings revealed that teachers did not practice inquiry-based teaching in the science classroom. Teachers of all four cases, comprehend almost same about the inquiry-based teaching. They did not comprehend inquiry approaches. Teachers' comprehension of inquiry was reflected in the classroom as teachers did not practice inquiry-based teaching in the science classroom. Concern stakeholders of all four cases did not comprehend the inquiry approaches that may reflect in teachers' comprehension and classroom practices. Mostly, curriculum documents (TB & TE) moderately addressed the inquiry approaches.

Research question 4: How do primary science teachers perceive the practiced assessment methods to achieve the intended learning outcomes?

The study proposed to explore teachers' perceptions about teachers' practiced assessment methods. The findings of the study revealed that teachers have somewhat comprehension of assessment methods. In all four cases, teachers comprehend almost the same (somewhat) assessment methods including assessment areas and tools of summative and formative assessment. Teachers' comprehension of assessment methods was somewhat reflected in teachers' practices of classroom and summative exams. In all four cases, concerned stakeholders also have somewhat comprehension of summative and formative assessment methods, which may be reflected in teachers' comprehension and practices. The information on formative assessment methods is somewhat addressed at TE and AG. However, only AG provided the focused areas of summative assessment.

Research question 5: How do primary science teachers perceive students learning toward achieving the intended learning outcomes?

Again, the study intended to explore teachers' perceptions of students' ILO achievement. The findings depict that; teachers have somewhat comprehension of the students' ILO achievement. In all four cases, teachers' perception was almost the same (somewhat) about students learning to achieve the ILOs by formative and summative assessment. Teachers' perception of students' ILO achievement was reflected in both students' class notebooks and exams. answer sheet also, where teachers did not assess students as such. Concern stakeholders of all four cases have the almost same perception (somewhat) about students'

achievement of ILOs by formative and summative assessment. Their perception may be reflected in teachers' perceptions and practices.

Research question 6: What challenges do primary science teachers face to practice inquiry in the science classroom?

The study projected to identify the challenges faced by the teacher to practice inquiry in the science classroom. The study identified some specific challenges for inquiry-based teaching practice. Teachers and concerned stakeholders have different perspectives on the identified challenges for inquiry-based teaching practice in science classrooms.

Research question 7: What is the effect of existing constructive alignments on developing curriculum documents?

Finally, the study aimed to explore, the effect of existing alignments on developing curriculum documents. The concerned stakeholders were engaged in teacher training, monitoring, and supervision; and also involved in developing curriculum documents. The existing status of concerned stakeholders' comprehension of the components of constructive alignment matches with the existing status of the curriculum documents. Therefore, their comprehension may be reflected in teachers' comprehension, and in developing curriculum documents.

7.3 Concluding Remarks

In education, learning outcomes, learning activities, and assessment are inextricably related and their alignment or high consistency has been crucial for achieving the goals of education. This connection among the three helps to make the overall learning experiences more transparent. Although a set of curriculum materials can be aligned with the curriculum's ultimate goals, achieving these goals largely depends on its actual mode of implementation in the classroom. Teachers are the most important link that connects intended learning outcomes, teaching-learning activities, and assessment through classroom practice.

The study found that teachers have somewhat comprehension of intended learning outcomes, learning activities, and assessments, which may not help them to connect ILOs, LAs, and As. The study also found that concerned stakeholders also have somewhat comprehension of ILOs, LAs, and As. Further, the study revealed that curriculum documents addressed the information of ILOs, LAs, and As, mostly somewhat. Moreover, the study found that the existing status of concerned stakeholders' comprehension of the components of constructive alignment matches the existing status of the curriculum documents. Therefore, the study concludes that concerned curriculum documents and concerned stakeholders may be responsible for teachers' comprehension as teachers get support from the concerned documents and concerned stakeholders.

Finally, the study established that in the primary science teaching practice of Bangladesh, constructive alignment does not exist among the intended learning outcomes (ILOs), learning activities (LAs), and assessment (A). The study also established that the concerned stakeholders' comprehension may be reflected in developing curriculum documents. The study hopes that, if the concerned stakeholders comprehend better, and if the concerned curriculum documents are properly addressed; then the teachers will comprehend better, and this will be reflected in their classroom practice. Therefore, constructive alignment will exist in primary science teaching practice in Bangladesh.

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Appendices

Appendix 1

General questionnaire for primary science teachers and concerned stakeholders

A. Comprehension of the focus of ILOs

- What is the intended learning outcome? please explain with example.
- What is the importance of the focus of ILO? please explain with example.
- How did you identify the focus of ILO? please explain with example.

B. Comprehension of the approaches of primary science textbooks (TB) and teacher's edition (TE)

i. Starting lesson with a key question

- What is the importance of key the question to start a lesson? please explain with example.
- what are the focuses of key questions starting a lesson in textbooks and teacher's edition? please explain with example.
- How do you/the teacher practice key questions to start a lesson in the science classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

ii Exploring students' prior knowledge

- What is the importance of exploring students' prior knowledge of the relevant topic? please explain with example.
- What are the scopes of prior knowledge exploration of lessons in TE and TB? please explain with example.
- How do you/the teacher explore students' prior knowledge in the class? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

iii. Real-life orientation with science concepts

- What is the necessity of linking real-life situations with science concepts? please explain with example.
- What are the scopes of linking real-life situations with science concepts in lessons in TE and TB? please explain with example.

iv. Science process skills

- What are the opportunities for students to achieve science process skills through science learning? please explain with example.
- What are the scopes of achieving science process skills through science learning in TB and TE? please explain with example.
- How do you/the teacher practice science process skills in the science classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

v. Activity-based class

- What is the importance of activity-based classes for science teaching? please explain with example.
- What are the scopes of activity-based classes in TE and TB? please explain with example.
- How do you/the teacher practice activity in the science classroom for students' science learning? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

vi. Collaborative approach

- What is the collaborative approach in science teaching-learning? please explain with example.
- What are the scopes of collaborative approach in TB and TE? please explain with example.
- How do you practice collaborative approach in the science classroom? please explain with example.

vii. Illustrations

- What is the importance of illustrations to achieve content knowledge? please explain with example.
- Do the provided illustrations are consistent with the content knowledge in TB and TE? please explain with example.
- How do you use illustrations to achieve students learning in classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

viii. Scope of scientific inquiry?

- What is inquiry-based teaching? please explain with example.
- What are the scopes of inquiry-based teaching in TB and TE?
- How do you/the teacher practice inquiry in science classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

ix. Lesson summary

- What is the importance of lesson summary? please explain with example.
- What is the provided information of lesson summary in TB and TE? please explain with example.
- How does lesson summary help you/the teacher in classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

C. Comprehension of practiced learning opportunities use in inquiry-based science teaching?

i. Step-1 Learners are engaged by scientifically oriented questions

- What is the importance of engaging students with scientifically oriented questions? please explain with example.
- What are the scopes of engaging students with scientifically oriented question in TB and TE? please explain with example.
- How do you/the teacher engage students with the scientifically oriented question? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

ii. Step-2 Learners give priority to evidence.

- What is the importance of giving students priority to evidence in responding to the question? please explain with example.
- What are the scopes of giving students priority to evidence in responding to the question in TB and TE? please explain with example.
- How do you/the teacher give students priority to give priority to evidence in responding to the question in the science classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

iii. Step-3. Learners formulate explanations from evidence to address scientifically oriented questions.

- What is the importance of formulating explanations from evidence to address scientifically oriented questions? please explain with example.
- What are the scopes of formulating explanations from evidence to address scientifically oriented questions in TB and TE? please explain with example.
- How do you/the teacher give students the scope to formulate explanations from evidence to address scientifically oriented questions in the science classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

iv. Step-4. Learners evaluate their explanations in light of alternative explanations.

- What is the importance to evaluate students' explanations in light of alternative explanations of their own? please explain with example.
- What are the scopes to evaluate students' explanations in light of alternative explanations of their own in TB and TE? please explain with example.
- How do you/the teacher give students the scope to evaluate their explanations in light of alternative explanations in the science classroom? please explain with example.
- What challenges do you/teacher face to conduct the approach in the classroom?

v. Step-5. Learners communicate and justify proposed explanations.

- What is the importance of learners' communication and justify their proposed explanations? please explain with example.
- What are the scopes of learners' communication and justify proposed explanations in TB and TE? please explain with example.
- How do you/the teacher give students the scope to learners' communication and justify proposed explanations in the science classroom? please explain with example What challenges do you/teacher face to conduct the approach in the classroom?

D. Perception of practiced assessment methods (formative and summative) to assess the ILOs

i. Formative assessment

- What are the focus areas of formative assessment during classroom assessment? please explain with example.
- What are the scopes of assessment areas on given activities in TE and TB? please explain with example.
- How do you focus the assessment areas during classroom assessment? please explain with example.
- What are the scopes of assessment tools in the provided activities of TE and TB? please explain with example.
- What assessment tools do you/the teacher practice in the science classroom? please explain with example.
- What challenges do you/teacher face to assess in the classroom?

ii. Summative assessment

- What are the focus areas of summative assessment? please explain with example.
- What is the instruction given in TE, TB, and AG about summative assessment? please explain with example.
- How do you/the teacher develop summative assessment questions? please explain with example.

- What challenges do you/teacher face to assess?

E. Perception about the extent of students' achievement of ILOs

i. Formative assessment

- How to understand to what extent the ILOs have been achieved during conducting lessons? please explain with example.
- What is the given information in TB, TE and AG about assess students' extent to the achievement of ILOs by formative assessment? please explain with example.
- How do you/the teacher assess the extent of student's achievement of the ILOs through formative assessment? please explain with example.
- How do you/the teacher assess the extent of students' achievement of ILOs? please explain with example.
- What challenges do you/teacher face to assess in the classroom?

ii. Summative assessment

- How do you/the teacher understand the extent of students' achievement of ILOs? please explain with example.
- How do TB, TE, and AG help you/the teacher to assess the extent of students' achievement of ILOs by summative assessment? please explain with example.
- How do you/the teacher assess the extent of students' achievement of ILOs by summative assessment? please explain with example.
- What challenges do you/teacher face to assess?

Appendix 2

General questionnaire for science education experts

1. Primary science teachers' comprehension was somewhat about the focus of ILOs in line with inquiry-based teaching-learning, as well as there are some challenges like inappropriate professional development programs, lack of collegial supervision, a lack of background knowledge in content and pedagogy, and lack of motivation. insufficient guides for connecting curriculum and inquiry teaching

-what is your opinion about this situation?

2. Primary science teachers have somewhat comprehension of the approaches of primary science textbooks and teacher's edition to facilitate inquiry-based teaching-learning, along with some challenges like: Inappropriate professional development programs, The threat of time management, Deficiency in inquiry-based instructional techniques and strategies, Resources available at the schools: Human and physical, Classroom management, lack of collegial supervision, insufficient guides for connecting curriculum and inquiry teaching, lack of motivation, The practical constrains of the learning context

- What do you think about this condition?

3. Learning opportunities for inquiry-based teaching did not practice in the science classroom, besides there are some challenges: Perspectives on the meaning of inquiry-Based teaching learning, The divergent perspectives of what constitutes appropriate guidance of inquiry, The threat of time management, Deficiency in inquiry-based instructional techniques and strategies, Inappropriate professional development programs, Commitment to inquiry, Classroom management, insufficient guides for connecting curriculum and inquiry teaching, lack of motivation, Management of extended activities, The practical constrains of the learning context

-what do you think about this practice?

4. Primary science teachers perceive somewhat the practiced assessment methods to achieve the ILOs with challenges, in addition to there are some challenges like:

Inappropriate professional development programs, Difficulty of Assessment, insufficient guides for connecting curriculum and inquiry teaching, lack of motivation

-what do you think about the situation of assessment?

5. Primary science teachers perceive somewhat the extent of students learning toward achieving the ILOs with some challenges, Difficulty of Assessment, insufficient guides for connecting curriculum and inquiry teaching, lack of motivation

-what do your opinion about the situation of students' ILO achievement?

6. what do you think about the existing situation of teaching practice?

7. How does this situation of primary science teaching practice effects on developing curriculum documents?

Appendix 3

General questionnaire for students of Focus Group Discussion (FGD)

A. Comprehension of the approaches of primary science textbooks (TB) and teacher's edition (TE)

i. Starting lesson with a key question

- How does your science class start? please explain with an example.
- Is there any question focus? please explain with an example.

ii Exploring students' prior knowledge

- Do your teacher ask you that you are going to read today before starting the lesson? explain with an example.

iii. Real-life orientation with science concepts

- How does your teacher explain the science concept and give activities or examples in science class? please explain with an example.

iv. Science process skills

- What do you do to prepare activities in science classes? please explain with an example.

v. Activity-based class

- How do you learn science concepts with activities in the science classroom? please explain with an example.

vi. Collaborative approach

- Do you do activities with others or do group discussions in the science classroom? please explain with an example.

vii. Illustrations

- How does your teacher relate the illustrations of TB with science concepts in the classroom? please explain with an example.

viii. Scope of scientific inquiry?

- How do you do activities in the science classroom? please explain with an example.

ix. Lesson summary

- How does your teacher summarize the class? please explain with an example.

B. Comprehension of practiced learning opportunities use in inquiry-based science teaching?

i. Step-1 Learners are engaged by scientifically oriented questions

- How does your teacher engage you with the scientifically oriented question? please explain with an example.

ii. Step-2 Learners give priority to evidence.

- How does your teacher give students priority to give priority to evidence in responding to the question in the science classroom? please explain with an example.

iii. Step-3. Learners formulate explanations from evidence to address scientifically oriented questions.

- How does your teacher give you the scope to formulate explanations from evidence to address scientifically oriented questions in the science classroom? please explain with an example.

iv. Step-4. Learners evaluate their explanations in light of alternative explanations.

- How does your teacher give students the scope to evaluate their explanations in light of alternative explanations in the science classroom? please explain with an example.

v. Step-5. Learners communicate and justify proposed explanations.

- How does your teacher give you the scope to communicate with others and justify proposed explanations in the science classroom? please explain with an example.

Appendix 4

Lesson observation schedule

Pre-determined approaches	Extremely	Moderately	Somewhat	not
Starting lesson with a key question				
Teacher's activity in classroom				
Exploring students' prior knowledge				
Teacher's activity in classroom				
Real-life orientation with science concept				
Teacher's activity in classroom				
Science process skills				
Teacher's activity in classroom				
Activity based class				
Teacher's activity in classroom				
Collaborative approach				
Teacher's activity in classroom				
Illustration				
Teacher's activity in classroom				
Scope of scientific inquiry				
Teacher's activity in classroom				
Lesson summery				
Teacher's activity in classroom				
Engaging students with a scientifically oriented question				
Teacher's activity in classroom				
Give them priority to evident of this question				
Teacher's activity in classroom				
Formulate their explanation				
Teacher's activity in classroom				
Explain their explanation				
Teacher's activity in classroom				
Evaluate and justify their explanation				
Teacher's activity in classroom				
Assessment in classroom				
Teacher's activity in classroom				

Appendix 5

Permission letter from DPE

গণপ্রজাতন্ত্রী বাংলাদেশ সরকার
প্রাথমিক শিক্ষা অধিদপ্তর
মিরপুর-২, ঢাকা ১২১৬
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স্মারক নং- ৩৮.০১.০০০০.৮০১.০৩.০২৫.২০১৯ 

তারিখ: ১৭ আষাঢ় ১৪২৫ বং
০১ জুলাই ২০১৯খ্রি:

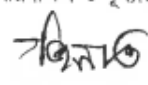
বিষয় : গবেষণা কাজে সার্বিক সহযোগিতা করণ।

উপর্যুক্ত বিষয়ের প্রেক্ষিতে জনাব রেজিন আহমেদ, সহকারি অধ্যাপক, শিক্ষা ও গবেষণা ইনস্টিটিউট, ঢাকা বিশ্ববিদ্যালয়, ঢাকা এর ‘Constructive Alignment in primary Science teaching practice towards inquiry and its effect on developing curriculum documents’ শীর্ষক গবেষণার কাজে তথ্য সংগ্রহের জন্য দেশের ০৮ (আট) টি বিভাগের বিভিন্ন জেলার সরকারী প্রাথমিক বিদ্যালয় সমূহে আগামী জুলাই ২০১৯ থেকে ডিসেম্বর ২০১৯ পর্যন্ত বিজ্ঞান বিষয়ক শিক্ষক, শিক্ষার্থী, পিটিআই ইন্সট্রাক্টর, ইউআরসি ইন্সট্রাক্টর ও সহকারি উপজেলা শিক্ষা অফিসের সাথে সাক্ষাৎকার গ্রহণ ও বিজ্ঞান শ্রেণিতে পাঠ্য পথ্যবেক্ষণ করার জন্য নিম্নে উল্লিখিত শর্ত সাপেক্ষে অনুমতি প্রদান করা হলো।

০২। বর্ণিত কারনে তাকে সার্বিক সহযোগিতা করার জন্য জেলা প্রাথমিক শিক্ষা অফিসার (সকল) নির্দেশ দেয়া হলো।

শর্তাদি:

- ক) প্রাপ্ত তথ্যাদি কোনরূপ প্রচার ও প্রকাশ করা যাবেনা।
- খ) তথ্যাদি শুধুমাত্র গবেষণার কাজে ব্যবহৃত হবে।
- গ) গবেষণালব্ধ তথ্যাদি প্রতিবেদন তৈরির পূর্বে অত্র দপ্তরকে অবহিত করতে হবে।

(মোঃ ফজলুল হক)
সহকারী পরিচালক
পরিবীক্ষণ ও মূল্যায়ন বিভাগ


অনুলিপি :

- ১। জেলা প্রাথমিক শিক্ষা অফিসার, সকল.....।
- ২। জনাব রেজিন আহমেদ, সহকারি অধ্যাপক, শিক্ষা ও গবেষণা ইনস্টিটিউট, ঢাকা বিশ্ববিদ্যালয়, ঢাকা
- ৩। মহাপরিচালক এর ব্যক্তিগত সহকারী (মহাপরিচালক মহোদয়ের সদয় অবগতির জন্য), প্রাশিঅ।
- ৪। অতি:মহাপরিচালক এর ব্যক্তিগত সহকারী (অতি:মহাপরিচালক মহোদয়ের সদয় অবগতির জন্য), প্রাশিঅ।
- ৫। পরিচালক (প ও মূ) এর ব্যক্তিগত সহকারী (পরিচালক মহোদয়ের সদয় অবগতির জন্য)।
- ৬। অফিস কপি।

Appendix 6

Explanatory Statement for teachers and concerned stakeholders

Date: January 2019

Title: Constructive Alignment in primary science teaching practice towards inquiry and its effect on developing curriculum document

I am Rezina Ahmed conducting research under the supervision of Dr. SM Hafizur Rahman, Professor, Department of Science Mathematic and Technology Education, Institute of Education and Research, University of Dhaka.

The purpose of my research is to explore the constructive alignment of the intended learning outcome, learning activities and assessment in primary science classroom practice towards inquiry approach and the effects of existing constructive alignment in developing curriculum documents through teachers understand on intended learning outcome and approach of primary science textbook and teachers' guide, employed learning opportunities focusing inquiry, practiced assessment methods (formative and summative), practiced grading methods, challenges faced by teaches. The proposed research aims to give participants an opportunity to express their opinion about their experience of science teaching.

The study involves video-recording classroom observation, audio-taping semi-structured interviews with science teacher, AUEO, instructor of PTI and URC, and focus group discussion (FGD) with students. Four science classes will be observed. The time needed for each interview and FGD is up to one hour (max). All of the questions relate to individual participant's understanding of science teaching and learning in their own experience. All participants will be given pseudonyms.

Only I will have access to the original data. The consent form, interview audiotape, classroom and FGD videotaped will be kept locked. After my research, all records will be destroyed. All data used in the thesis will be anonymized, nobody will be named and no individual will be identifiable in any way.

Researcher's name:

Signature:

Thank you so much for your nice cooperation!!!

Appendix 7

Consent Form of science teachers

Title: Constructive Alignment in primary science teaching practice towards inquiry and its effect on developing curriculum document

Note: This consent form will remain with the Dhaka University researcher for records

I agree to take part in the Dhaka University research specified above. I have read the explanatory statement, which I keep for my records. I understand giving consent means that I am willing to:

1. be interviewed by the researcher	Yes	No
2. allow the interview to be audio-taped	Yes	No
3. to make myself available for a further interview if required	Yes	No
4. complete questionnaires asking me about science teaching	Yes	No
5. allow the classroom observation to be video-taped	Yes	No
6. allow the students focus group discussion to be video-taped	Yes	No

I understand that my participation is voluntary in the research. All information gathered through this interview will be used exclusively for the purpose of research and anonymity of respondents will finally be ensured. You are guaranteed that you will not be identified in any report of the results of the study.

I understand that any data that the researcher extracts from the interview/focus group discussion/audio and video-taped for use in the thesis reports will not, under any circumstances, contain names or identifying characteristics.

I understand that I will be given a transcript of data concerning me for my approval before it is included in the write up of the research.

I understand that the information which I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the research, or to any other party.

I understand that data from the interview/focus group discussion/audio and video-taped will be kept in a secure storage and accessible to the researcher only. I also understand that the data will be destroyed after a 5years period unless I consent to it being used in future research.

Participant's name:

Signature:

Thank you so much for your nice cooperation!!!

Appendix 8

Consent Form of AUEO, Instructor of PTI and URC

Title: Constructive Alignment in primary science teaching practice towards inquiry and its effect on developing curriculum documents

Note: This consent form will remain with the Dhaka University researcher for records

I agree to take part in the Dhaka University research specified above. I have read the explanatory statement, which I keep for my records. I understand giving consent means that I am willing to:

1. be interviewed by the researcher	Yes	No
2. allow the interview to be audio-taped	Yes	No
3. to make myself available for a further interview if required	Yes	No
4. complete questionnaires asking me about science teaching	Yes	No

I understand that my participation is voluntary in the research. All information gathered through this interview will be used exclusively for the purpose of research and anonymity of respondents will finally be ensured. You are guaranteed that you will not be identified in any report of the results of the study.

I understand that any data that the researcher extracts from the interview, focus group discussion, audio and video-taped for use in the thesis reports will not, under any circumstances, contain names or identifying characteristics.

I understand that I will be given a transcript of data concerning me for my approval before it is included in the write up of the research.

I understand that the information which I provide is confidential, and that no information that could lead to the identification of any individual will be disclosed in any reports on the research, or to any other party.

I understand that data from the interview, focus group discussion, audio and video-taped will be kept in a secure storage and accessible to the researcher only. I also understand that the data will be destroyed after a 5 year period unless I consent to it being used in future research.

Participant's name:

Signature:

Thank you so much for your nice cooperation!!!