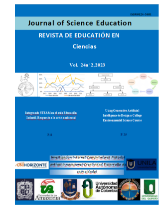
Journal of Science Education Vol.24 n° 2 2023

Journal of Science Education

ISSN 0124-5481



Contextualized Teaching and Learning of Science in Primary Schools

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A R T I C L E I N F O

Keywords:
Contextualization
Teaching Learning
Science
Primary school

A B S T R A C T

The purpose of this study was to investigate contextualization of teaching and learning of science in primary schools. A case study design was employed for the study. The data was collected from purposely selected 6 teachers and 34 students using interviews, FGD, classroom observation, and document review and analyzed thematically. The findings of this study demonstrated that science teachers hold both fundamental and context-based beliefs concerning the teaching and learning of science. The qualitative data revealed that teachers faced a number of problems in not adequately translating their strong expressed beliefs and perceived CTL competence into actual classroom practices..

1. Introduction

Education should be aligned with students' needs and desires, and the curriculum should be relevant to their life experiences as well. In this regard, primary education is the cornerstone and the most significant factor that plays a key role in preparing young learners for further education by making curriculum material applicable to their real-life experiences (Gilbert, 2006). He also proposes that an educational context can have four attributes such as the setting of focal events, behavioral environment, specific language and extra-situational background knowledge. These attributes can be used as criteria needed for the successful use of context in science subjects. The following attributes are identified: students must value the setting, and recognize that it falls within the domain of respective science subjects. It must arise from the everyday lives of the students, or social issues and industrial situations that are of contemporary importance to society; the behavioral environment must include problems and activities that are clear exemplifications of scientific important concepts, so that students engage in activities from the domain of science subjects, such as experimental laboratory skills. The behavioral environment is set by learning activities and enables discussion among the learners; learners should be enabled to develop a coherent use of specific respective science subject's language which is brought into focus by the behavioral environment; and the behavioral environment and the language used to talk about it should relate to relevant extra-situational, background knowledge, building productively on that prior knowledge.

However, although primary education is broadly conceived as a fundamental factor for social, cultural, and economic progress, the emphasis on theory and the lack of context, i.e., the failure to connect the content of the curriculum with students' everyday lives, has resulted in a lack of students' interest and curiosity in pursuing their education (Barmby, Kind & Jones, 2008; Tsaparlis, Hartzavalos, & Nakiboglu, 2013). Many countries are now advocating the values of science education, albeit the way it is presented in line with the life experiences of students has become the subject of criticism among policy-makers, teachers, educators, and researchers (De Vos, Bulte, & Pilot, 2002; van Berkel, Vos, Verdonk, & Pilot, 2000).

These days, international research continues to provide evidence that students benefit from the proper design and execution of the curriculum in ways that take into account the real-life experiences, social contexts, cultures, and local characteristics of students in compliance with the principles of differentiation, personalized learning, and curriculum contextualization (Fernandes, Mouraz, & Figueiredo, 2013; Crick, 2014). To address such diversified issues in the notion of curriculum contextualization in primary schools, different stakeholders such as curriculum experts, practitioners, students, and the community are expected to play a tremendous role. Specifically, teachers are considered key agents in making the science curriculum more relevant to the daily life experiences of students. To accomplish this responsibility, they need to have appropriate and adequate beliefs, knowledge, attitudes, and skills approach so as to make science education more active, effective, relevant, creative, and fun for students.

Science teachers must understand the philosophical foundations on which any instructional approach is grounded in order to properly execute it in the teaching-learning process (Leu, 2000). Thus, becoming acquainted with these issues is critical in order to provide some insight into the implications of philosophical orientations for the teaching-learning process in

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Accepted 1 November 2023, Available online 10 March 2024

general and context-based science teaching and learning in particular.

Context-based science is generally characterized by the adoption of a student-centered approach to teaching that requires students to engage in meaningful activities rather than memorization (Overman, Vermunt, Meijer, Bulte, & Brekelmans, 2013). Such student-centered approaches to curriculum organization have their origins in constructivist theories that stress the value of the active creation of their knowledge by learners. Constructivist approaches, in particular, are based on the principles that students must be actively involved in order to gain understanding. Hence, it can be deduced that contextualized experiences and environments are in contrast to de-contextualized experiences and environments, where the context is mostly scholastic, abstracted away from actual events and from the content knowledge as it is typically used in practice (Rivet & Krajcik, 2004).

There is growing international and national awareness about the need to encourage science education relevant to the emerging knowledge society. Despite a rapidly changing environment, few changes have occurred in the pedagogical approaches utilized in science classrooms. Science education has emphasized conceptual knowledge communication, the use of key, abstract concepts to understand and explain typical problems, the consideration of context as mainly secondary to concepts, and the use of practical labor to just show principles and practices (Tytler, 2007). Context-based science instruction is the use of situations or events that occur outside of science class and are of particular interest to students to guide the presentation of science ideas and concepts in order to promote understanding of the information being taught (Rivet & Krajcik, 2004; Smith, 2010). Thus, based on the foregoing discussions and perspectives of various scholars, it is clear that context-based teaching and learning is rooted in constructivist philosophy and that its instructional process is directly tied to students' life experiences. Furthermore, the context-based approach's essential tenet is that contexts and applications of science should be used as the starting point for the development of scientific ideas. This is in contrast to more conventional or traditional approaches, which first address scientific theories before moving on to applications.

Teachers play a critical role in creating context-based learning environments in the classroom (Taconis et al., 2016). Furthermore, in order to arouse students' interest and motivation in context-based learning environments, teachers must demonstrate the necessary knowledge, abilities, and attitude by implementing "active learning" approaches (Bennett et al., 2005). For integrating CTL in science teaching, various researchers (e.g., Johnson, 2002; Sears, 2003; Sears & Hersh, 2000) have proposed a number of strategies such as inquiry, problem-and project-based learning, cooperative learning, and authentic assessment. The teacher is required to have appropriate knowledge, attitude, and skills for handling and guiding the classroom environment using shared or lose control and for making students active participants in the teaching-learning process rather than tightly controlling the instructional process in a traditional manner under the regulation competence of context-based science education. Teachers' perceptions of actual and preferred context-based constructivist learning environments were explored by (Ongowo, 2013).

Context-based teaching and learning are believed to be influenced by teaching experience. As teachers have gained experience, they have incorporated new self-concepts and reorganized their self-schema to accommodate new experiences and extend effective teaching practices. Teaching experience has been related to greater understanding and knowledge basis for effective educational practices (Liu, Jones, & Sadera, 2010). Apart from addressing the issue of contextualization as the basis of science teaching and learning in primary schools, the preliminary document evaluation reveals that the curriculum framework suggests a number of context-based teaching and learning strategies. Experiments, project-based learning, cooperative learning, problem solving, inquiry, field visits, and other strategies for primary school science subjects are often recommended (MoE, 2002). It indicates that the applications of scientific concepts are expected to be incorporated into the content of each chapter of science textbooks.

Although the study of context-based approaches has been given greater consideration in developed countries, efforts to investigate the practice of curriculum contextualization in the Ethiopian primary education context were found to be scant. For example, Taylor and Mulhall (1997) investigated the prevalence and effectiveness of situating primary school subjects in the context of agriculture. They reported that primary school teachers' experience of intentionally designing and implementing the principle of curriculum contextualization in the teaching and learning process was found to be inadequate. They further indicated that various internal and external factors were to blame for the inadequacies. Contextualization, according to many scholars (e.g., Brown 1998) is rooted in a constructivist approach to teaching and learning. Individuals learn by constructing meaning by interacting with and interpreting their environments, according to constructivist learning theory (Brown 1998). The meaning of what people learn is linked to their life experiences and contexts; it is built by learners rather than offered by teachers; and learning is grounded in real-life situations and problems.

This study looked at science teachers' beliefs and competences to implement context-based learning environments in the classroom. The theoretical construct by which this study informed advocates teachers' beliefs, self-perceived competences and practices of context-based teaching and learning approach in science. The Education and Training Policy and its Implementation document argues that learners would be given opportunity to deal with real-life problems in various contexts during the teaching and learning process, allowing them to consolidate and extend basic scientific and technology abilities. Furthermore, as mentioned in the background section, the existing Curriculum Framework for Ethiopian Education (2009) places the student and his or her experiences at the core of the learning process. This way of teaching and learning in the existing curriculum is grounded on a constructivist viewpoint. . Hence, the theoretical framework that guided this study was constructivist theory, which enables us to understand the interplay between the nature of science instruction and the context. Context-based science education is founded on the constructivist principle that content should be within the learner's horizons (Labudde, 2008).

The CTL Framework that was presented here was founded on existing science education research and theory. The researcher expected that one of the major factors influencing the implementation of a context-based approach in the science classroom would be the belief of science teachers. Teachers, according to Bybee (1993), are "change agents" in educational reform, and their beliefs must not be ignored. Beliefs, according to Bandura (1986), are the best predictors of people's decisions throughout their life. According to Pajares (1992), teachers' beliefs influence their perceptions, which in turn influence their classroom practice. Teachers' beliefs are defined as their general views for science teaching in relation to both the traditional and context-based approaches to science education.

One of the major causes of the problems could be poor pedagogical practices, which have been prevalent in science education for a long time. As mentioned earlier, in Grades 7 and 8, natural sciences such as biology, physics, and chemistry are taught independently as separate sciences, and in the separate sciences, topics would again benefit from themes in which scientific concepts are related to everyday life to make them as meaningful as possible to students. This implies that the context-based approach in its basic form is expected to be well understood and addressed by science teachers in Ethiopian primary school science classrooms. The questions that need to be raised are: Do the primary school science teachers in Ethiopia have the necessary beliefs, knowledge, and skills to teach the science curriculum using a context-based approach? How would the teachers view and put into practice the basic philosophy and principles of curriculum contextualization in their classrooms? In other words, the problem of this study focused on examining the extent to which science teachers have favorable CTL beliefs and are capable to address students' everyday life experiences using a context-based teaching approach.

Objective of the Study

Objective of this study was to explore science teachers' beliefs, perceived competence and practices of CTL in public primary schools.

Basic Research Questions

1. Why do science teachers hold both fundamental science teaching beliefs (FSTB) and context-based teaching and learning beliefs (CTLB)?
2. How do they express their self-perceived competence (knowledge and skills) and their actual experience of incorporating CTL dimensions into science classrooms?
3. How do they describe the influence of their preferred beliefs and perceived CTL competence on their CTL practices?
4. How do biology teachers in the emphasis dimension and urban and experienced teachers in the redesigning dimension relatively outperform their counterparts?

2. Qualitative Study

Research Design

A multiple, cross-case research design was employed to collect and analyze qualitative data (Stake, 1995; Yin, 2009). According to Yin case study as an empirical inquiry that "investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p.13). As previously stated, the purpose of this study was to investigate the overarching phenomenon of the context-based approach to science instruction from the viewpoint and experience of teachers. To acquire a better understanding of science teacher beliefs, perceived competence, and practice related to CTL, multiple, cross-case study was used. There are two reasons why a case study design was used for this study to obtain a deeper understanding of science teachers' beliefs, perceptions, and practices toward CTL. First, a case study has distinct advantages for answering "how" and "why" questions. Second, if the researcher is more interested in the process than the outcome, a case study is a good option. Single case studies and multiple case studies are two different types of case studies that fall under the same methodological framework (Yin 2009). Therefore, a multiple-case design comprised of six different cases was deemed to be appropriate for the proposed study. According to Yin (2009), data from multiple cases is often more powerful than evidence from single-case designs, and the study's overall results may be considered more valid and credible.

Case Selection

Cases were selected for multiple case study analysis and for developing the interview questions for the qualitative study. So, the cases for the qualitative follow-up analysis were selected. This study employed a two-stage case selection procedure. Because of this mixed-methods study is explanatory, the researcher decided first to concentrate on the typical case for each group (biology, physics, and chemistry teachers). To select a typical respondent from each group, the following systematic procedure was employed: Based on three composite variables (i.e., CTL beliefs, perceived competence, and CTL practices). As a result, all eligible participants from each group with mean scores of one standard deviation below and above the expected mean value were identified. This numeric information is presented in Table1.

Table 1: Number of Cases per Group

Group	Cases scored one standard deviation above the expected mean	Cases scored one standard deviation below the expected mean
Biology	4	11
physics	4	13
chemistry	6	11

Using a maximal variation sampling strategy, two participants from each of the three groups with different characteristics (sex, years of teaching experience, and school location) were purposefully selected in the case of selection procedure (Creswell, 2016). Accordingly, the overall sampling procedure produced an equal number of two teachers from each science discipline, three female and three male teachers, three urban and three rural schools, two teachers with less than five years of experience, one teacher with six to ten years of experience, one teacher with sixteen to twenty years of experience, and two teachers with twenty years or more of experience, which allowed the researcher to present multiple perspectives of participants to "represent the complexity of our world" (Creswell, 2016). The summary information for each case study participant is presented in Table 2 below:

Table 2: Teacher Participants for multiple case studies

Participants	Code	sex	School Code and location	Subject	Years of experience	Date of intervie
Teacher 1	BT1	F	SC1(Urban)	Biology	16	Nov 10/20
Teacher 2	BT2	M	SC2(Rural)	Biology	25	Dec 14/20
Teacher 3	PT1	F	SC3(Urban)	Physics	10	Nov 30/20
Teacher 4	PT2	M	SC4(Rural)	Physics	4	Nov 17/20
Teacher 5	CT1	F	SC5(Urban)	Chemistry	28	Nov 23/20
Teacher 6	CT2	M	SC6(Rural)	Chemistry	3	Dec 07/20

Each participant was given a code to ensure confidentiality. The anonymous codes used to represent the participants were BT1 and BT2 for biology teachers, CT1 and CT2 for chemistry teachers, and PT1 and PT2 for physics teachers. Moreover, participants with the codes BT1, CT2, and PT2 were chosen from the low summed mean score group in the above-mentioned scales, whereas those with the codes BT2, PT1, and CT1 were chosen from the high summed mean score group.

2.1. Qualitative Data Collection

The primary data collection technique used in this study was in-depth semi-structured interviews with two participants from each of the three participant groups. This study also used multiple sources, such as focus group discussion, classroom observation, and document review, to validate the information obtained during the interviews and to provide a rich description of the cases (Stake 1995; Creswell 2011).

2.2. Semi-Structured Interview

An interview is ‘ a data-collection method in which an interviewer asks questions of an interviewee ’ (Johnson & Christensen, 2008, p. 203). According to Creswell (2013), follow-up qualitative interviews in an explanatory sequential mixed methods design helped to clarify unclear, contradicting, or unusual survey responses. There was a series of predetermined questions for teacher interviews (N = 6). Four professors with experience in qualitative research methodology examined the semi-structured interview checklist, which was then revised based on their suggestions. Teachers were interviewed in semi-structured, one-on-one sessions. Follow-up questions were asked as appropriate throughout the interviews to clarify responses and encourage elaboration.

2.3. Focus Group Discussion

In educational research, the utilization of focus group discussions is becoming more common (Cohen et al., 2005). Focus groups are a type of group interview that rely on group interaction to explore a topic provided by the researcher. Focus group discussion is the process of gathering information through interviews with a group of people, usually, four to six (Creswell, 2011). In this study, therefore, students, who were attending in the selected six science teachers’ schools, interacted with one another in order to assess their teachers’ effort of incorporating context-based learning environments during the science classroom. Students were selected purposefully with respect to their achievement in science subjects. The researcher asked their corresponding science teachers (i.e., those who were involved in the qualitative phase) to divide the students into three categories like high, middle and low achievers with respect to their science lessons (biology, physics and chemistry) to get a variety of views and opinions about a particular issue on the research under consideration. The researcher then selected two students from each category. As a result, four to six participants per six groups (N = 34) participated in the discussions.

2.4. Classroom Observation

The other instrument in this study was classroom observation, which was carried out after the interviews were completed. This study used a non-participant naturalistic observation format. It was naturalistic in the sense that the observations were conducted in regular classrooms where students were attending science classes. The researcher sat at the back of the classroom and simply observed and recorded what was going on in the classrooms as events were presented or unfolded in class. Furthermore, the participants were encouraged to act normally or do things the way they normally did them from the start, as they would not be penalized or reported to anyone.

Specifically, because of the nature of an explanatory sequential design, considerable discussions were held with the six teachers prior to classroom observation about the objective of the classroom observation, the issues to be observed, the topic(s) of their choice, and the date of observation. As a result, it was reasonable to assume that all of the selected topics (see Table 3 from each science subject textbook appeared to be suitable for examining the extent to which the basic dimensions of CTL were implemented by the teachers in their respective science classrooms.

Table 3: Summary of Lessons Observed from the six Teachers

Teacher Code	School Code and Location	Lesson topic	Date of classroom observation
BT1	SC1(Urban)	1. Yeast	Nov 11/2023
		2. Organs	Nov 16/2023
BT2	SC2(Rural)	1. Farm Animals	Dec 14/2023
		2. Food and Water Need of Ruminants	Dec 17/2023
PT1	SC3(Urban)	1. Electric circuits	Dec 01/2023
		2. Voltage	Dec 04/2023
PT2	SC4(Rural)	1. Applications of Atmospheric Pressure	Nov 17/2023
		2. Heat Energy	Nov 20/2023
CT1	SC5(Urban)	1. Nitrogen	Nov 23/2023
		2. Oxygen	Nov 27/2023
CT2	SC5(Rural)	1. Air Pollution	Dec 07/2023
		2. Water Pollution	Dec 11/2023

2.5. Document Review

Documents or artifacts provide information about people's experiences, knowledge, actions, and values (McMillan & Schumacker, 2010). The document review was conducted after obtaining information through interviews. The documents reviewed in this study included teachers ' lesson plans, handouts/worksheets, assignments, teacher-made tests, and supporting curricular materials (if any) that might be prepared by science teachers to adapt the formal science curriculum to the real life of students. Reviewing such materials was assumed to be helpful for obtaining additional information on how science teachers' views, abilities, and practices on CTL were reflected in the teaching and learning process. As Creswell (2011) and Stake (1995) suggested, triangulation of different data sources in a case study analysis is critical because it contributes to the richness and depth of the case description.

2.6. Qualitative Data Collection Procedures

The study aimed at developing an in-depth understanding of the beliefs, perceived competence and practices of the participants about CTL in science classroom learning environments. To make the process of the case study systematic and effective, the following simple protocols were employed during the collection of data.

1. Permission to conduct a field visit in schools was sought.
2. Made a preliminary visit to the selected six teachers, to talk about the study, and arranged the logistics of the interviews, FGDs and observations. Drew up a time schedule with the teacher and student participants.
3. Interviewed teachers, who were teaching grade 8 Biology, Physics & Chemistry.
4. Interviewed six groups of selected students from the corresponding six selected science teachers.
5. Made two lessons classroom observations in each of the selected six science teachers.
6. Reviewed classroom documents such as instructional plans, assignments, tests
7. Organized data for analysis

After qualitative data collection, data transcription and coding were made and then data were thematically categorized based on similarities and analyzed. More specifically, the qualitative analysis procedures were discussed below.

3.Qualitative Analysis

When we want to understand participants' experiences, thoughts, or behaviors on a certain problem, thematic analysis is an effective method of analysis (Kiger et al, 2020). So, the thematic analysis seemed appropriate for this study because the research questions mainly centered on participants' views, perceptions, and experiences of CTL.

The most widely used framework for conducting thematic analysis is a six-step process that includes familiarizing yourself with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (Braun & Clarke, 2008). While there are a variety of qualitative analysis software packages available, textual data were coded using Microsoft Word's "comments" feature manually.

In the qualitative phase of this study, first the text data obtained through the individual interviews, focus group discussions, observations and document reviews were transcribed verbatim. Here, preliminary exploration of the data was done to get a general overview of the data or transcript by reading through and understanding it. Next, using deductive approach (Patton, 2016), a set of codes were identified based on the research questions. These set of codes then lead to generate a pre-determined core themes (e.g., teachers' beliefs, perceived competence, and practices of CTL) and subthemes. To make the coding easier and manageable, Code categories or subthemes were color-coded (see Appendix J). For instance, teachers' beliefs about teaching fundamental science and context-based teaching and learning science were used as subthemes for teachers' beliefs about teaching and learning science theme analysis. Context handling, regulating students' learning, teaching emphasis, and redesigning curriculum materials were used as subthemes for both perceived CTL competence and CTL practices for separate theme analysis. Data from FGDs, observation and document transcripts were mainly used to explore teachers' actual CTL practices in the science classrooms. Finally, after constructing descriptions for each case, cross-case thematic analysis was conducted to report the findings.

3.1. Determination of Trustworthiness

To guarantee the trustworthiness of the qualitative phase, the following factors were considered: credibility, transferability, dependability, and confirm ability of findings.

3.2. Credibility

The credibility the study is determined by its ability to measure what it is supposed to measure. Qualitative research demands establishing results that are believable from the participant's perspective. This is equivalent to the concept of validity in quantitative studies. To address this issue, two main strategies were used. The first was triangulation, multiple sources of data gathered from interviews, FGDs, observation, and document review from different sources (teachers and students) to check if the conclusions were consistent across sources. Another strategy was member-checking, which allowed participants to confirm or challenge the transcriptions of what they had said. After the transcriptions were completed, each participant was contacted and provided the draft transcripts to review the validity of the content of the descriptions. Consequently, all of the participants who took part in the member check agreed to all descriptions, with minor modification.

3.3. Transferability

Transferability means the extent to which the findings can be transferred to another context, which is equivocal to "generalizability" in quantitative research. The findings of the study cannot be generalized to reflect teachers' beliefs, perceived competence, and practices across the country, but they can be applied to other samples within the population with similar generalizability contexts or proximal similarity patterns (Trochim & Donnelly, 2001), such as the same curriculum, comparable teacher characteristics, cultural patterns of teaching and learning, and cultural backgrounds of participants. I presented and discussed the findings, as well as excerpts from science teachers' interview transcripts and observation notes, so that readers could learn more about the participants' experiences and practices.

3.4. Dependability

Dependability indicates the stability of results over time. The issue was addressed through a clear explanation of the methods to be used. In this section, efforts were made to thoroughly discuss the research design, the data gathering process, and the process of analysis. Furthermore, attempts were made in this study to implement recommendations. To maintain reliability (dependability) in qualitative research, he recommends documenting the numerous procedures carried out during the study, double-checking the transcripts for errors, and ensuring that the meaning of the codes remains consistent.

3.5. Confirm ability

The consistency of data and its interpretation is referred to as confirm ability. This was addressed using triangulation and a confirm ability audit. In the latter strategy, I asked a Curriculum and Instruction Ph.D. candidate to examine whether or not the findings, interpretations, and conclusions were supported by data. Furthermore, in order to achieve the criterion of confirm ability, I did my best to base the study's results as much as possible on data and literature, and I provided the arguments and explanations for the findings.

3.6. Potential Ethical Considerations

Since mixed-methods combine quantitative and qualitative research, ethical considerations need to attend to typical ethical issues that surface in both forms of inquiry. In this study, the following ethical issues were considered: Before knocking on the doors for data collection, I used the letter granting ethical approval from Bahir Dar University to obtain permission from the research sites. This helped to create the necessary communication with sample schools for receptivity issues and clarification of the objectives of the study. Explanations of the research objectives were also made with the sample respondents. This, in fact, helped the researcher to address the ethical considerations of the research by ensuring the respondents' willingness to freely cooperate in filling out the questionnaire items and by assuring the respondents that the information would be kept confidential and be used only for academic purposes. All study data, including the survey data, interview tapes, and transcripts, were kept properly and destroyed after a reasonable period of time.

4. Qualitative Results

The present study adopted an "explanatory sequential mixed methods design" (Creswell, 2016), the qualitative data were analyzed and the results are reported. In the qualitative case study, six science teachers and 36 corresponding students were selected from six sample primary schools. From these sample schools, a lot of data were collected using several data collection tools (i.e., teacher interviews, classroom observations, FGD with students, and document reviews).

Participants

In this study, survey teacher participants were given the opportunity to participate in a follow-up face-to-face interview and for classroom observations. As already discussed in the methodology section, six primary school science teachers working in different schools were purposefully selected for the qualitative phase study based on their willingness, survey data results, and pertinent characteristics for the study. In addition to the interviews conducted with different six science subject teachers, FGDs were conducted with a sample of 34 corresponding students (four to six participants per group). Moreover, classroom observations were conducted to look for evidence of teachers' practices of CTL during actual teaching. The next sections present the findings of the qualitative data based on face-to-face interviews with the teachers, students' focus group discussions, classroom observations, and document reviews.

4.1.Teachers' Beliefs about Teaching and Learning Science

Teachers' beliefs about teaching fundamental science assess the extent to which teachers believe in the scientific theories that are taught first, because it is thought that this knowledge can provide a basis for understanding the natural world and that this knowledge is necessary for the student's further education. On the other hand, the teachers' beliefs about context-based teaching and learning science focus on assessing the extent to which science teachers hold the necessary beliefs about the importance of the knowledge development process in science and the relationship between Science, Technology, and Society (STS), which are the basic aspects of CTL. Context-based science teaching and learning can be characterized by the use of contexts and applications as a starting point for developing scientific understanding.

The findings from the interviews confirmed the survey results, indicating that science teachers had a combination of fundamental and context-based beliefs about the teaching and learning of science in upper primary schools. For instance, supporting the fundamental beliefs, the analysis of the interviews of the three science teachers (BT1, PT2 & CT2) revealed that the fundamental science teaching approach, which emphasizes the teaching of fundamental concepts followed by contexts, is highly important in science classroom instruction. When asked why they prioritize the fundamental science approach, two of the interviewed teachers (PT2 and CT2), both of whom have a strong belief in fundamental science teaching, explained that they were frequently forced to deliver the concepts of their subjects through clear explanations and direct demonstrations rather than having students explore different problems or contexts due to the poor conceptual background of students in the sciences. Furthermore, the interview results of the aforementioned science teachers indicated that the situation of the schools, such as large class sizes in science classes, a lack of laboratory equipment and facilities, a lack of on-the-job professional training on various innovative pedagogical approaches, and so on, might have reinforced these "traditional", fundamental science teaching beliefs.

The information from the teacher interviews shows two competing viewpoints in general. On the one hand, science teachers claim that students grasp science subjects better when fundamental concepts are effectively conveyed by teachers. On the other hand, they believe that by utilizing CTL, students can understand the relationship between science and their real lives as well as to improve their science knowledge, attitude, and skills.

4.2. Science Teachers' Perceived Competence on the Dimensions of CTL

This section presents interview data on primary science teachers' self-perceived competence in context-based science teaching and learning. The findings from data were obtained from six science teacher interviews. These teachers were interviewed to further probe how they perceived their knowledge and skills for using CTL dimensions in their science classes. Thus, the results of data using interview are discussed by taking into account the results of those four subscales (Context-Handling, Regulation, Emphasis and Redesigning) of the teachers' self-perceived competence in context-based science teaching and learning. When asked why they don't convert their science curricula adaptation ability into actual practice, all of the participating teachers interviewed remarked that teachers' lack of enthusiasm, dedication to their jobs, other demanding responsibilities, time constraints, lack of resources, and lack of incentive mechanisms are some of the challenges that limit their ability to adapt science curricular materials into classroom The interview results of the teachers (BT2, PT1, and CT1) revealed that, while not all efforts were made to the expected level, they tried to make science subjects as relevant to students' daily life as possible. These teachers expressed the following responses:

Although my practical experience of linking biology concepts to different contexts was not adequate, various activities pertaining to students' personal lives, the environment, technology, etc. are suggested at the bottom of each topic in the current biology textbook. ....perhaps this opportunity to some extent allowed me to connect biological concepts to various circumstances on occasion. For instance, to teach "the role of biology in agriculture" in the classroom, I tried to provide some key explanations regarding the issue at hand before attempting to connect the concept to the students' everyday lives. For example, after teaching my students about the benefits of agrochemicals, I tried to raise very familiar examples that helped students easily understand the benefits of agrochemical usage for preventing diseases of crops Instruction. Participants were asked about their reasons for not adequately considering real-life contexts in teaching science subjects. All of the participants reiterated that one of the main reasons they did not frequently consider a variety of contexts in their classrooms was that much emphasis had been placed on covering the entire topics and preparing students for regional exams. As a result, they were forced to stick to a fixed timetable, which prevented creative teaching approaches like CTL from being used in science classrooms.

4.3. Science Teachers' Practices of CTL

The data obtained from different instruments, namely students' FGDs, teachers' interviews, class observations, and teachers' lesson plans, were analyzed in line with the basic dimensions of CTL practices in the science classroom.

The results of the teachers' interviews and students' FGDs were congruent with the classroom observation results. Each classroom was observed for the degree to which each participant teacher showed relevance between the content and students' lives. This was determined by observing how the participant teachers discussed their specific subject's content in relation to students' life events outside the schools and their applications to real-world situations. During observations, the researcher was able to note examples that illustrated responses to the subscale of context handling.

The results of classroom observation on the context handling dimension indicated that the conventional approach to teaching and learning was found to be the most prominent strategy in many of the primary science classes observed in the schools. Although the observed lessons' topics appeared to be relevant to context-based learning (for example, Air Pollution in Chemistry, Heat Energy in Physics, and Farm Animal Use in Biology), the observed teachers' efforts to connect these concepts to students' real-life experiences were found to be insufficient.

In general, although the attempt of the teacher (CT2) to involve students in the lesson was encouraging, his actual experience of relating the concepts to the real life of students by carefully selecting relevant contexts seemed to be poor. His teaching approach seems to be founded on his belief that students can learn from curricular materials (textbooks) rather than from their prior knowledge and experience, which contradicts the underlying assumptions of CTL. During the observation of the BT2 class, students also sat in small groups to discuss with one another. "What did we learn in the last period?" the teacher asked as the class began. Some students informed the teacher about the previous lesson's topic, while the teacher simultaneously posed some quick questions that were related to the past lesson. When his students sought to answer questions, he encouraged them. Then he summarized the previous lesson again, emphasizing key aspects. Following that, he introduced the daily lesson topic "Uses of Farm Animals in Biology" and asked his students to open their textbooks.

5.Discussions of the Major Findings

5.1. Teachers' Beliefs about Teaching and Learning Science

The qualitative findings of the study revealed that various factors, such as teachers' past school experience, overload of content, considering science as a hard subject, the poor conceptual background of students in the sciences, background knowledge, the emphasis on preparing students for regional examinations, large class sizes in science classes, a lack of laboratory equipment and facilities, and a lack of on-the-job professional training, appeared to be the main reasons for teachers to give more emphasis to the fundamental science teaching beliefs than CTL beliefs. The concentrations of fundamental science, which mainly focus on transmitting conceptual knowledge, solving problems, and understanding abstract concepts, are important parts of science education, but they can lead to concepts being isolated from real-world applications (King, 2012). In the current literature, however, CTL is widely emphasized in science education that uses contexts and the application of science as the starting point for situating science learning in real-life situations and for the development of scientific ideas (Bennet, 2005; Bennet et al. 2006; Springer, 2009).

5.2. Teachers Level of Perceived Competence for Teaching CTL

This study attempted to explore the perceived competence primary science teachers to teach science subjects using CTL in their classrooms. In this study, it was assumed that in order to effectively implement CTL in their classes, teachers first and foremost needed to have high competency in the dimensions of CTL. The competence of science teachers to teach science subjects using a context-based approach is determined first and foremost by their competency in the CTL dimensions. Furthermore, the researcher's critical review of the working primary science curriculum reveals that, even though the dimensions of CTL competences are not explicitly stated as De Putter-Smits et al. (2013) do, the fundamental concepts underlying each dimension of CTL are addressed in the Ethiopian primary school science curriculum. For instance, to address teachers' context-handling competence, the curriculum framework suggested that "in the separate sciences in Grades 7 and 8, scientific concepts are expected to be related to the everyday lives of students. According to the qualitative result, during science classroom instruction, teachers felt capable of selecting relevant contexts and tying them to relate to students' real lives outside of school. In fact, the teachers admitted that they were not capable of properly identifying contexts that would spark students' interest in applying scientific theories to real-life situations. They pointed out that they exclusively focused on the contexts expressed in science textbooks, and contexts are presented after concepts. In connection to this, some researchers (Taconis, den Brok, & Pilot, 2016) argue that contexts should be accessible, understandable, and relevant to students in order to be effective.

5.3 Teachers' Practices of CTL

As discussed in this paper elsewhere, there is a worldwide trend towards context-based instruction in both primary and secondary science classrooms (Bennett, Lubben, & Hogarth, 2007; Gilbert, 2006), and this tendency is characterized by the adoption of a student-centered approach to teaching, which requires students to engage in meaningful activities rather than rote learning (Overman, Vermunt, Meijer, Bulte, & Brekelmans, 2012). Specifically, when science teachers use CTL in their lessons, they need to consider the basic dimensions of context-based competences. Moreover, another issue to consider when implementing a context-based teaching approach is the extent to which teachers are involved in re-designing current instructional materials. This is due to the fact that science curriculum materials are often not relevant for every classroom or every student's diverse learning demands. According to the analysis, many science teachers still choose to teach their subjects using the content-oriented, traditional approach due to the aforementioned factors. Students were also unable to undertake even the most basic scientific practical experiments. As a result, the educational system was disconnected from practice, and it was neither relevant nor capable of addressing the country's problems.

Conclusions

The findings on teachers' beliefs revealed those primary science teachers' beliefs about science teaching and learning did not cluster into any one belief dimension. Overall, it was found that respondents tended to support both the fundamental science teaching and the CTL beliefs to which they were asked to respond. The fundamental nation of "Fundamental science teaching" received strong support, with the main aim of introducing students to the fundamental concepts and skills within science in order to prepare them for future education. There was also strong support for the CTL beliefs, which aim to teach students how to communicate and make decisions about social issues involving science, as well as to teach students to see science as a culturally determined system of knowledge that is constantly evolving. The findings also revealed that teachers perceived the context-handling, regulating students' learning, and redesigning dimensions of CTL to be used in their classes on occasion. The emphasis dimension of CTL was found to be the least implemented in the science classroom. The qualitative data gathered from various sources appeared to back up the survey findings by demonstrating that implementing CTL in science classrooms was fraught with various problems, as stated in the discussion section.

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