Context-based teaching and learning practices in upper primary science classrooms in East Gojjam administrative Zone, Ethiopia

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Abstract: The main purpose of this study was to examine teachers’ self-perceived practices of context-based science teaching and learning in science classrooms. To achieve this purpose, a cross-sectional survey design was employed. The data were collected from 360 upper primary science teachers in East Gojjam Administrative Zone, Ethiopia. A multistage sampling technique was employed to select the participants. A Context-Based Learning Environment in Science (CBLES) instrument was adapted and validated to measure teachers’ self-perceived practices of context-based approach in science classes. Factor analysis unveiled the confirmation of the four-factor structure of the instrument with good reliability coefficients ranging from 0.891 to 0.945 and the constructs had adequate discriminant validity as the mean correlation coefficient (r) values were less than 0.80. Results revealed that the components of context-based teaching and learning were moderately implemented in upper primary school science classrooms as perceived by teachers. In comparison, biology teachers in the emphasis component, urban teachers in the re-
designing component, and experienced teachers (those who taught above 20 years) in the re-designing component were comparatively found in a better way than their counterparts. The findings have important implications for school science teachers and science curriculum developers to have a better understanding of how upper primary teachers implement components of the context-based approach in science classrooms. The primary teacher education institutions will also benefit from this study in order to examine their efforts of preparing prospective science teachers using various educational innovations including context-based science teaching and learning.

**Subjects:** Classroom Practice; Continuing Professional Development; Curriculum Studies

**Keywords:** Perceived practice; science; context-based teaching and learning; upper primary school

1. Introduction

In today’s global education system, science education is expected to become more meaningful, relevant, and inspiring for students when concepts are taught in the context of the real world (Gilbert, 2006; Vogelzang et al., 2019). However, in many countries, the traditional, de-contextualized approaches to teaching and learning still persist in the science classrooms (Asabere-Ameyaw et al., 2012; King, 2016; Msimanga & Shizha, 2014; Osisioma, 2017). Memorizing conceptual knowledge, applying concepts to routine problems, presenting contexts as secondary to concepts, and using practical work to explain principles and procedures are all examples of such traditional pedagogical approaches (Tytler, 2007). As a result, many students’ interest and engagement in science appears to be waning in a number of countries around the world (King, 2016).

In response to science teaching and learning-related problems, various approaches have been developed over the last two decades to make science education more understandable, interesting, and relevant to students (Podschuweit & Bernholt, 2018). In this sense, context-based teaching and learning (hereinafter CTL) has been recognized as an alternative and widely used approach that aims to make science education meaningful for students by placing learning in a real, relevant and interesting environment (Acar & Yaman, 2011; Bennett et al., 2007; Chen & Cowie, 2013; Gilbert, 2006; King, 2012; Podschuweit & Bernholt, 2018).

In Ethiopia, like many other developing countries, although significant progress has been made in providing more young people with access to primary education, poor quality and lack of relevance of science education is the most critical problem in the upper primary and secondary schools (Ministry of Education, 2002; Ministry of Education, 2005, 2017). Specifically, science education is highly criticized as the curriculum is overloaded with isolated facts and concepts, lacks relevance to learners’ everyday lives, lacks coherence within and between concepts and contexts, lacks relevance to transfer learned knowledge to situations outside the classroom as well as to trigger the interest of students (Ministry of Education, 2002, 2009; Ministry of Education, 2017). Such and other related issues in science education may have contributed to the rise in the high drop-out rate of Ethiopian students from primary school, particularly in rural areas (Ministry of Education, 2009; Ministry of Education, 2017). In addition, science achievement among upper primary students appears to be decreasing at an alarming rate (National Educational Assessment and Examinations Agency [NEAEA], 2016). For instance, the extent of underachievement in the national learning assessments (NLAs), particularly in science subjects (biology, chemistry, and physics), conducted at grade 8 from 2000 to 2016 showed that the mean score of the students in the subjects was below 50%. Poor pedagogical approaches, which have been prevalent in science education for a long time, may be one of the major causes of the problems (Ministry of
Education, 2017). To address the problems, among other educational innovations, curriculum contextualization has been boldly and vividly suggested as one of the strategies in the existing science curriculum framework (Ministry of Education, 2009) and in the newly established Ethiopian Education Road Map (Ministry of Education, 2017). However, how teachers implement this important educational innovation in the Ethiopian upper primary science classrooms has not been investigated.

Research (e.g., Fernandes et al., 2013; Hartnell-Young & Vetere, 2008; Macedo, 2013; Priestley, 2010) reveals that students benefit and successful when the curriculum development process and the classroom instructional activities take into consideration their social backgrounds and cultures, as well as local characteristics, in line with the notions of differentiated instruction and curricular contextualization. In this respect, teachers can have an active role by assuming their part as curriculum makers, more specifically, by designing science lessons that are more in line with the characteristics of the contexts in which they teach and of the students being taught (Leite et al., 2018).

A review of literature on context-based science education from teachers’ perspectives shows that a substantial number of previous studies have focused predominantly on understanding/views/perceptions, importance/benefits, effects/contributions, and challenges of the CTL. For instance, researchers (Gercek & Ozcan, 2015; King, 2007) found that teachers have different misunderstandings about the concept of context-based science teaching. Teachers feel that bringing a context-based approach into the classroom will boost students’ understanding of concepts in science, according to the findings of certain studies (e.g., Bennett et al., 2005; Fensham, 2009; Kazeni & Onwu, 2013; Stanisavljević et al., 2016). Some researchers (e.g., Eshetu & Assefo, 2019; Kazeni & Onwu, 2013) found that teachers believe the CTL approach helps students develop problem-solving skills more effectively than the traditional approach. According to the results of some researchers, teachers believe CTL has the potential to increase students’ interest, attitudes, and motivation for studying science (e.g., Bennett et al., 2007; Parchmann et al., 2006; Vogelzang et al., 2019; Walan, 2016). Other studies (e.g., Bennett et al., 2007; Gilbert et al., 2011; King & Ritchie, 2012) revealed that teachers believe context-based science teaching helps students link the concept of science with their everyday lives. Research has also shown the challenges teachers face during CTL implementation are primarily related to the problem of selecting interesting contexts, teachers’ workload, lack of time, extensive content coverage, large class size, teacher control needs, and the pressure to prepare students for national exams (e.g. King, 2007; Leite et al., 2018; Walan et al., 2016).

Despite the fact that teachers can play a tremendous role in the effective implementations of context-based science teaching and learning, their self-perceptions on the actual practices of CTL in the science classrooms have scarcely been investigated (King, 2016; Ottevanger et al., 2016; De Putter-Smits et al., 2013; Vos et al., 2010; Walan et al., 2016; Wieringa et al., 2011).

Specifically, current literature on context-based science education shows that the concern of examining teachers’ self-perceived competences (context-handling, regulation, emphasis, and re-designing) in the implementation of CTL in the primary science classrooms is barely investigated (De Putter-Smits et al., 2013). Although the first three components of CTL (context-handling, regulation, emphasis) were investigated by these researchers, the practice of teachers in re-designing the science materials and instruction was not explored. This research, therefore, hopes to address this inadequacy of knowledge in science education. On the other hand, we know that the CTL approach is widely used in science education worldwide, but there is a lack of measurement instruments to examine teachers’ self-perceived practices of this approach in science classrooms. In this regard, attempts were made to adapt and validate a Context-Based Learning Environment in Science (CBLES) instrument, which was proposed by De Putter-Smits et al. (2013), to measure teachers’ self-perceived practice of context-based approach in science classrooms. Thus, it could be helpful for other researchers to understand and examine science teachers’ self-reported practices of CTL in any other context. Furthermore, it is
unfortunate that teachers’ perceived practices of CTL in relation to different science disciplines, teachers’ years of experience, and school location have not been adequately investigated in science. Examining teachers’ self-perceived practices of CTL in light of these variables is therefore desirable to strengthen the current literature on context-based science teaching and learning.

1.1. Context-based science teaching and learning
Since the term “context” is so important in this paper, its definition needs to be clarified before the concept of “context-based teaching and learning” can be discussed. Researchers use different definitions and characteristics of “context” to describe the term in the context of science education. Bennett et al. (2005) explained while context can have many meanings, it may apply, in its broadest sense, to the social and cultural setting in which the student, teacher, and institution are located, or to the application of a scientific theory more narrowly.

For our purposes, we have chosen the definition of “context” given by De Jong (2008). He attempted to clarify the meaning of contexts for science teaching and learning by identifying four domains as the origin of contexts. These are personal, social, and society, professional practice, and scientific and technological domains. Every domain is important because schools must contribute to the personal development of students by integrating science into their personal lives. De Jong explains these domains using specific examples. That is, in the context of the personal domain, it connects science with the student’s personal life (health, food, clothing, etc.). In the context of the social and societal domain, issues such as crime, climate change, the effects of acid rain, and the social and social spheres, including the role of students in community and social issues. In professional practice, the domain context is related to providing information for future jobs or careers. The field of science and technology refers to the context that includes the discovery and innovation of science and technology. Its main objective is to increase the student’s understanding of the application of science and technology.

Context-based teaching and learning (CTL) is founded on pragmatism philosophical ideas, and it is primarily influenced by John Dewey’s (1916) pragmatism philosophy, which emphasizes the importance of experience over theory. According to him, we learn to think and reason by thinking and solving practical problems that arise in our experience. The curriculum and teaching methods advocated by Dewey should be related to the children’s experiences and interests, as well as the physical and social environment in which they learn. The real experience of the learner becomes the basis of teaching.

CTL has different definitions, each of which is based on different perspectives. In our study, we adopt the following descriptive definitions: CTL in science is an approach that helps students take responsibility for their own learning, uses context as a means of establishing concepts, requires a teaching emphasis appropriate to the contexts, and demands adaptation of science (De Putter-Smits et al., 2013). Its main purpose is to support the students in understanding and making learning meaningful to students by connecting the subject matter contents to their personal, social, and cultural life situations (Baker et al., 2009; De Jong, 2008; Yu et al., 2015). Furthermore, CTL mainly focuses on the use of contexts and application of science as a means of enhancing scientific understanding of students’ real-worlds while developing students’ capacities to function as responsible participants in their everyday lives (Aikenhead, 2006; Bennett et al., 2007).

1.2. Competences of CTL implementation
There is a consensus in the literature that the actual practice of any educational innovation is highly affected by school teachers. Specifically, to address the notion of CTL in the science classroom, De Putter-Smits et al. (2013) suggested that teachers should have the necessary competences of creating a context-based learning environment. The competences comprise “context-handling, regulating students’ learning, adequate emphasis, and re-designing of science materials” (p. 3). Hence, in this study, it is assumed that context-based science teaching and learning is most likely to be successfully implemented in classrooms if teachers have the following competences of CTL.
1.2.1. Context-handling
As stated by De Putter-Smits et al. (2013), “context handling refers to the teacher competence in handling contexts, establishing concepts and making the concepts transferable to other contexts” (p. 11). In this component, the teacher is expected to have the capability to present the context in science curriculum material effectively to the students. Teachers may encounter materials with contexts they are unfamiliar with. They further noted that teachers are required to be capable to familiarize themselves with any context expressed in science curriculum material and to be able to present and clarify it to the students. The competency of context-handling also includes the choice of which context to use, how to use this context, which concepts are appropriate in the context, and how to make concepts transferable to other contexts (Gilbert, 2006). With regard to the selection contexts, reviewed literature (e.g., Basu & Barton, 2007; Belloccchi et al., 2016; Savelsbergh et al., 2016) highlights the involvement of learners in the selection of interesting and relevant contexts for effective CTL. If this condition is overlooked, learners can face challenges in contexts that do not meet their needs, expectations, as well as time and environmental preferences (e.g., De Jong, 2008; Pilot & Bulte, 2006). This study, therefore, focused on examining how science teachers practice the context-handling component during context-based teaching and learning from a teacher perception perspective.

1.2.2. Regulating student learning
Teachers must be skilled in regulating the learning process so that learners are given the ability and learning environment to create their own meaning of learning materials by using a context-based approach (Zimmerman & Schunk, 2001). Under the regulation competence of context-based science education, the teacher is required to have appropriate competences of handling and guiding the classroom environment using shared or loose control so that students will actively be involved in the teaching-learning process (De Putter-Smits et al., 2013). In the context-based science teaching and learning approach, teachers should be competent in promoting students’ sense of ownership and responsibility both on the subject as well as on their own learning (Gilbert, 2006; Parchmann et al., 2006). In reviewing the literature, however, the practices of science teachers for regulating students’ learning in a context-based learning environment appear to be lacking. The study, therefore, explored the perceptions of science teachers on granting learners more autonomy and responsibility when teaching science using a context-based approach.

1.2.3. Teachers’ teaching emphasis
The emphasis of context-based science education is that science knowledge needs to be used to answer important questions that people encountered in their everyday lives, not just to provide answers about theoretical sciences. To measure teachers’ teaching emphasis competence, De Putter-Smits et al. (2013) identified two dimensions of context-based science teaching. These include uncertainty and investigation. Uncertainty refers to the extent to which opportunities are provided for students to experience scientific knowledge as arising from theory-dependent inquiry involving human experience and values, and as evolving, non-foundational, and culturally and socially determined. In short, uncertainty relates to the degree to which learners experience scientific knowledge as provisional or tentative. The investigation is related to the extent to which there is an emphasis on skills and inquiry and their use in problem-solving and investigation in a classroom. This research, therefore, attempted to examine whether the emphasis was given to the issue of uncertainty and investigation by science teachers during CTL implementation.

1.2.4. Re-designing science curriculum and instruction
Another factor that could affect the practice of the context-based teaching approach is the level of teachers’ competency in re-designing the existing teaching materials. Of course, the success of context-based teaching depends on the quality of the curriculum materials, and their effective implementation inside and outside the classroom (Prins et al., 2018). However, teachers’ interpretations and adaptations are vital in determining how educational innovation is performed in the classroom, and it has long been known that they do not always implement an innovative curriculum exactly as it was intended (Van Den Akker, 2004). Besides, science curricular resources aren't always sufficient for every classroom or every student's particular learning needs. As a result,
teachers need to adopt the teaching materials to suit the environment of their classroom and the resources available at their school (De Putter-Smits et al., 2013). Tzou and Bell (2010) stated that teachers need to adapt the science teaching materials to link to students’ interests and experiences so as to enhance students’ perceptions of the relevance of science to their everyday lives. De Jong (2008) attempted to clarify the use of contexts for science teaching and learning by identifying four domains as the origin of contexts. These are personal, social and society, professional practice, and scientific and technological domains. By considering these domains, teachers can redesign the science curriculum during their classroom teaching. The need for re-designing teaching materials is more expected in context-based education than in conventional education, and it necessitates more effort on the part of the teacher. Teachers, therefore, need to have some competences in adjusting the materials for classroom instruction. Thus, this study aimed at examining the experience of teachers on adapting science teaching materials for classroom instruction.

Researchers’ critical review on the working upper primary science curriculum shows that although the components of CTL are not systematically structured in a manner addressed by De Putter-Smits et al. (2013), the fundamental concepts behind each component of CTL are addressed in the Ethiopian upper 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 life of students to make them as meaningful as possible to students” (Ministry of Education, 2009, p. 17). In all science subjects, teachers’ competence in regulating student learning is widely reiterated in the working science curricula (Ministry of Education, 2002, 2009; Ministry of Education, 2017). To address the issue of emphasis, learners are required to experience scientific knowledge as provisional or tentative, and learners would have the opportunities to participate in problem-solving and investigation activities in the classroom. The issue of re-designing, which is related to adapting the science curriculum and instruction, is one of the responsibilities of not only science teachers but also all other subject teachers.

The issue of context-based science education, in general, and the basic components of competences of CTL, in particular, are well articulated in the Ethiopian upper primary science curriculum framework. Nonetheless, the level of teachers’ perceptions regarding the application of CTL in science classrooms seems to be barely investigated. To the best of researchers’ knowledge, no previous study has been conducted on teachers’ perceptions regarding the implementation of CTL in Ethiopian upper primary science classrooms. Therefore, the main purpose of this study was to examine science teachers’ self-perceived practices of context-based teaching and learning (context-handling, regulation, emphasis, and re-designing) in science classrooms. Specifically, this study attempted to answer the following research questions:

- Is the Context-Based Learning Environment in Science (CBLES) survey a valid and reliable instrument to measure teachers’ perceived context-based teaching practices in upper primary science classrooms in East Gojam Zone, Ethiopia?
- To what extent do science teachers practice context-based teaching and learning components (context-handling, regulation, emphasis, and re-designing) in their classrooms?
- Are there significant differences in their practices of CTL with respect to their subject areas, years of teaching experience, and school location?

2. Research design
A quantitative research approach, particularly a cross-sectional survey design, which is the most popular form of survey design in education was employed (Creswell, 2009). The design helped to investigate the current self-perceived practices of CTL, and to examine if there were significant differences among respondents in their practices due to their subject areas, length of teaching experiences, and school location.
2.1. Samples and sampling procedures

A multi-stage sampling procedure was involved in selecting the sample of this study. The first stage was related to the selection of sample woredas (districts). In the East Gojjam Administrative Zone, there are nineteen woredas. Out of these, nine woredas were selected using simple random sampling. The second stage in the sampling procedure was the selection of the schools from the sampled woredas. In the nine woredas, there are about 266 upper primary schools. Of the nine woredas, a total of 78 upper primary schools (30%) were selected using a simple random technique (lottery method). The third stage in the sampling procedure was the selection of the respondents from the sampled schools. A total of 360 upper primary school science teachers in East Gojjam Zone, Ethiopia, responded to the questionnaire. The participant teachers were selected proportionally using stratified random sampling to get adequate representations of groups that would be relevant for the study. Stratified random sampling was used for the selection of teachers based on their subject areas, teaching experiences, and school location.

2.2. Instrumentation

To measure science teachers’ perceived practice of context-based teaching and learning, a Context-Based Learning Environment in Science (CBLES) survey proposed by De Putter-Smits et al. (2013) was adapted and modified to suit the study by the researchers. Four scales of the CBLES (context-handling, regulation, teaching emphasis, and re-designing, see Table 10) were used. Items related to teachers’ self-perceived practice of each scale were measured with the self-report instrument having a five-point Likert scale ranging from 1 (Never) to 5 (Always).

2.3. Procedures

In this study, for a better understanding of items, all the measures were translated into Amharic language and back translations were also made by two graduate students, one from the Ethiopian language and the other from the English language from Bahir Dar University (BDU). Based on their comments, some items were deleted and changed accordingly. The questionnaire was improved by modifying or replacing some items that were found to be quite vague.

Afterward, the content of the survey questionnaire and the wording of the items were examined by a group of professors who are teaching in the Department of Teacher Education and Curriculum Studies at Bahir Dar University. A debriefing meeting with these professors was conducted, where they provided feedback on whether the survey content was representative of all the possible questions about science teachers’ perceived practices of the components of CTL. Based on their feedback, the researchers incorporated some comments and made some changes in the survey format and the wording of items. It was proposed to eliminate some items of the questionnaire, and few items were removed accordingly.

Finally, the administration of the questionnaire was performed after getting approval from the BDU, respective woreda education offices and school officials found in East Gojjam Administrative Zone. Following this, informed verbal consent was obtained from all participants before the administration of the questionnaire. The investigators had provided orientation to the science teachers as to the nature and purpose of the instruments and attempted to make the participants feel at ease. Then, the instrument was administered to participants during their free periods with close supervision of the researchers.

2.4. Data analysis

The survey data collected were first used to establish the instrument’s psychometric properties, including factor structure, internal consistency reliability, and discriminant validity. The overall science teachers’ perceived practice of CTL was analyzed using descriptive statistics such as means and standard deviations. One-way analysis of variance (One-way ANOVA) was used to check whether there are significant differences among science teachers in their perceived practice of CTL components due to their subject areas (biology, physics, and chemistry), years of teaching experience, and school location. Independent samples t-test was used to test if there exists
a significant mean difference in the perceived practice of teachers on CTL due to their school location. Moreover, MANOVA was performed in examining the influence of demographic variables on the CTL components.

3. Results

3.1. Exploratory factor analysis results of science teachers’ self-perceived practices of context-based teaching and learning

To measure teachers’ perceived context-based teaching practices in science classrooms, a total of 30 items of the CBLES Scale were subjected to principal component analysis (PCA) with Varimax rotation. Prior to performing PCA, the suitability of data for factor analysis was assessed. Inspection of the correlation matrix revealed the presence of many coefficients with 0.3 and above. The Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy value of 0.812, exceeding the recommended value of 0.6 (Kaiser, 1970), and Bartlett’s Test of Sphericity (Bartlett, 1954) reached statistical significance, supporting the factorability of the correlation matrix. On the perceived CTL practice scale, the first four-component solution explained a total of 65.173 of the variance, with Component 1 contributing 25.57%, Component 2 contributing 16.78%, Component 3 contributing 12.99% and Component 4 contributing 9.81% (see Table 1). The eigenvalues were greater than 1 for each of the four factors, ranging from 2.94 to 7.67.

Overall, the pattern of factor loadings provided satisfactory support for a priori structure of the CBLES, as suggested by the scale authors (De Putter-Smits et al., 2013). However, few items in the scale had low factor loading and low communalities. This implies that there was a need for modification or removal of some of the questionnaire items in the instrument. As a result, item-15 in the Regulation scale and item-16 in the Emphasis scale loaded below 0.30, and had low communality value (0.143 and 0.057 respectively) were excluded and the PCA was run again. The researchers presume that the main reason for the low factor loadings on these items was that most teachers either did not understand the essence of the items or lacked practical experience in their classroom practices.

3.2. Reliability of the instrument

Regarding the use of Cronbach’s Alpha in Science Education Studies, Taber (2017) noticed that a value of around 0.70 or greater is widely considered desirable. Further De Vaus (2004) suggests the relationship between one item and the rest of the items (i.e., item-total correlation) in the scale should be at least 0.30. Accordingly, as depicted in Table 2, the reliability coefficient alpha of all constructs considered in this study ranged from $\alpha = 0.891$ (Context Handling) to $\alpha = 0.945$ (Emphasis) which was quite acceptable.

Moreover, it is evident from Table 2 that item-total correlation values in the present study were found well over the minimum requirement (0.30) for an item not to be deleted.

3.3. Validity of the instrument

Lastly, to validate the teacher questionnaire for its constructs, the data were subject to discriminant analysis of each scale of the questionnaire (that is, using the mean correlation of the scale with the other three scales as an index). Table 3 provides the mean correlation values for each scale of the teacher questionnaire.

As depicted in Table 3, the mean correlation coefficients ranged from 0.513 for Regulation to 0.710 for Emphasis scale. These indices suggest that the scales are distinct, which satisfies the discriminant validity of the items. This is because all the mean correlation coefficient ($r$) values were less than 0.80 (i.e., $r \leq 0.80$), which met the required criterion of discriminant validity according to Brown (2006).
| Item                                                                 | EM   | RG   | CH   | RD   | Communalities |
|---------------------------------------------------------------------|------|------|------|------|---------------|
| 25. Students do context-related investigations to answer my questions.| 0.95 |      |      |      | 0.922         |
| 24. Students do context-related investigations to answer questions that interest them. | 0.95 |      |      |      | 0.918         |
| 22. Students do context-related investigations to answer questions that they talk about in class. | 0.93 |      |      |      | 0.898         |
| 20. Students do context-related investigations or experiments.       | 0.91 |      |      |      | 0.889         |
| 21. Students think about the evidence to support statements.         | 0.88 |      |      |      | 0.836         |
| 23. Students explain what different statements, pictures, and graphs mean. | 0.86 |      |      |      | 0.76          |
| 17. Students learn that scientific explanations have changed overtime | 0.67 |      |      |      | 0.49          |
| 18. Students learn that context-based science is influenced by cultural values and opinions. | 0.65 |      |      |      | 0.432         |
| 19. Students learn that context-based science is a way to raise questions and seek answers. | 0.58 |      |      |      | 0.345         |
| 9. Students help me to decide which context-based task/assignment works best for them. |      | 0.89 |      |      | 0.825         |

(Continued)
|   |   |   |   |
|---|---|---|---|
| 10. Students have a say in deciding how much time they spend on a context-based activity | 0.88 |   | 0.798 |
| 8. Students help me to decide how well they are learning during context-based science | 0.87 |   | 0.784 |
| 11. Students help me to assess context-based learning. | 0.86 |   | 0.803 |
| 7. Students help me to plan what they are going to learn during context-based learning | 0.76 |   | 0.615 |
| 14. Students ask other students to explain their ideas | 0.61 |   | 0.378 |
| 12. Students talk with other students about how to solve context-based problems | 0.56 |   | 0.34 |
| 13. Students explain their ideas to other students | 0.51 |   | 0.291 |
| 6. Students get an understanding of life outside of the school. | 0.83 |   | 0.76 |
| 3. Students learn about the world inside and outside of school. | 0.82 |   | 0.695 |
| 5. I carefully choose and give contexts that interest students to apply into their everyday life. | 0.82 |   | 0.726 |
| 4. I use a variety of students’ everyday experiences to explain scientific concepts. | 0.81 |   | 0.746 |

(Continued)
|   |   |   |   |
|---|---|---|---|
| 2. I make students learn to relate what they learn in the classroom to their life outside of school. | 0.79 |   | 0.668 |
| 1. I use carefully contexts that are expressed in the science textbook and relevant to learners | -0.32 | 0.68 | 0.576 |
| 16. Students learn that science cannot always provide answers to problems |   |   | 0.057 |
| 28. I adapt the curriculum materials with community and environmental issues |   |   | 0.95 |
| 29. I adapt the curriculum materials with the professional practice during classroom teaching |   |   | 0.91 |
| 30. I adapt the curriculum materials with technological innovations and applications. |   |   | 0.9 |
| 26. I adapt the curriculum materials based on the availability of resources in the schools. |   |   | 0.84 |
| 27. I fit the curriculum materials with students’ personal life |   |   | 0.71 |
| 15 Students to be asked by others to explain their ideas |   |   | 0.143 |
| % Variance | 25.578 | 16.788 | 12.997 | 9.810 |
| Eigenvalue | 7.67 | 5.03 | 3.89 | 2.94 |

Factor loadings greater than 0.30 were accepted. The samples consisted of 360 science teachers.

Note. EM emphasis, RG regulation, CH context handling, RD re-designing.
Taken together, the results from the factor analysis, as well as the indices of scale reliability and validity (Cronbach’s alpha reliability index and the discriminant validity index), suggest that the CBLE survey is reliable and valid for measuring teachers’ perceived context-based teaching practice in upper primary school science classes in Ethiopia and therefore can be used with confidence by teachers and researchers in the future.

### 3.4. Teachers’ self-perceived practices of context-based science teaching and learning

To assess teachers’ self-perceived practices of context-based science teaching in East Gojjam Administrative Zone, the descriptive statistics, that is, the mean and standard deviation for each

| No. | Scale             | No. Items per Scale | Reliability Coefficient | Corrected item-total correlation |
|-----|-------------------|---------------------|-------------------------|----------------------------------|
| 1   | Context Handling  | 6                   | 0.891                   | 0.724                            |
| 2   | Regulation        | 8                   | 0.9                     | 0.687                            |
| 3   | Emphasis          | 9                   | 0.945                   | 0.795                            |
| 4   | Re-Designing      | 5                   | 0.911                   | 0.81                             |

| Scales                      | Mean Correlation | No. of Items |
|-----------------------------|------------------|--------------|
| Context Handling            | 0.599            | 6            |
| Regulation                  | 0.513            | 8            |
| Emphasis                    | 0.658            | 9            |
| Re-Designing                | 0.710            | 5            |

| Scales         | N  | Mean | Std. Deviation |
|----------------|----|------|----------------|
| Context handling | 360 | 3.06 | 0.38           |
| Regulation      | 360 | 3.19 | 0.85           |
| Emphasis        | 360 | 2.80 | 1.08           |
| Redesigning     | 360 | 3.15 | 0.76           |

| Scales             | Biology | Chemistry | Physics | Differences |
|--------------------|---------|-----------|---------|-------------|
| Context handling  | 3.05    | 3.06      | 3.06    | .037        |
| Regulation         | 3.18    | 3.29      | 3.09    | 1.532       |
| Emphasis           | 2.97    | 2.73      | 2.62    | 3.475       |
| Re-designing       | 3.17    | 3.10      | 3.18    | .381        |

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### 3.4. Teachers’ self-perceived practices of context-based science teaching and learning

To assess teachers’ self-perceived practices of context-based science teaching in East Gojjam Administrative Zone, the descriptive statistics, that is, the mean and standard deviation for each
### Table 6. Results of post Hoc test on emphasis perceived practice scale based subject areas

| (I) Subject | (J) Subject | Mean Difference (I-J) | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|-------------|-------------|-----------------------|------|-------------------------------------|-------------------------------------|
| Biology     | Chemistry   | .24010                | .182 | −.0794                              | 5.596                               |
| Physics     | Biology     | −.24010               | .182 | −.5596                              | .0794                               |
| Chemistry   | Physics     | .34894*               | .033 | −.0223                              | .6755                               |
| Physics     | Chemistry   | −.10883               | .743 | −.4577                              | .2400                               |

*The mean difference is significant at the 0.05 level.

### Table 7. Perceived practice of teachers on CTL based on years of teaching experience

| Scales            | Mean | Differences |
|-------------------|------|-------------|
| Context handling  | 3.04 | 2.99        |
| Regulation        | 3.1  | 3.2         |
| Emphasis          | 2.74 | 2.94        |
| Re-designing      | 2.84 | 3.16        |

### Table 8. Results of post hoc test on re-designing scale based on years of teaching experience

| (I) Experience | (J) Experience | Mean Difference (I-J) | Sig. | 95% Confidence Interval Lower Bound | 95% Confidence Interval Upper Bound |
|----------------|----------------|-----------------------|------|-------------------------------------|-------------------------------------|
| below 5 years  | 6–10 years     | −.39333*              | .017 | −.7405                              | −.0462                              |
|                 | 11–15 years    | −.32104               | .077 | −.6626                              | .0205                               |
|                 | 16–20 years    | −.37519*              | .022 | −.7147                              | −.0357                              |
|                 | above 20 years | −.49548*              | .002 | −.8562                              | −.1348                              |
| 6–10 years      | 11–15 years    | .07229                | .977 | −.2668                              | .4114                               |
|                 | 16–20 years    | .01814                | 1.000| −.3189                              | .3551                               |
|                 | above 20 years | −.10215               | .936 | −.4605                              | .2562                               |
| 11–15 years     | 16–20 years    | −.05415               | .992 | −.3854                              | .2771                               |
|                 | above 20 years | −.17444               | .657 | −.5274                              | .1785                               |
| 16–20 years     | 11–15 years    | .05415                | .992 | −.2771                              | .3854                               |
|                 | above 20 years | −.12029               | .881 | −.4712                              | .2306                               |
| above 20 years  | 16–20 years    | .12029                | .881 | −.2306                              | .4712                               |

*The mean difference is significant at the 0.05 level.
of its components (context-handling, regulation, emphasis, and redesigning) were computed. The results were presented in Table 4 below.

When the teachers’ perceived practices were analyzed, the overall results indicated that the upper primary science teachers almost reported that they have implemented the components of CTL in the classroom “sometimes” (M = 3.05; SD = 0.38) as they were asked to rate their self-perceived practices on a five-point scale ranging from Always (5) to Never (1). Furthermore, when the four components were examined, the findings revealed that except for the Emphasis scale (M = 2.80; SD = 1.08), the mean scores of Context handling (M = 3.06; SD = 0.38), Regulating student learning (M = 319; SD = 0.85), and Re-designing science curricula (M = 3.15; SD = 0.76) were a bit higher than the average mean score (3.00). Therefore, the results depict that teachers perceived that the regulation component of CTL was more practiced compared with the others while the emphasis component was rarely practiced.

3.4.1. Teachers’ Self-perceived practice of CTL based on subject areas
The results in Table 5 show that there was a statistically significant difference among the mean scores of teachers of different subjects (F2, 357) = 3.475, P < 0.05) only for the Emphasis scale. However, for the other scales (context handling, regulation, and redesigning), the differences were found to be not statistically significant at the p<0.05 level. As far as the effect size is concerned, according to Cohen’s et al. (2005) guideline, an effect size (eta-squared) with a value of 0.01 = very small effect, 0.06 = moderate effect and 0.14 = very large effect. Thus, despite reaching statistical significance, the actual difference in mean scores between the groups was quite small as the effect size of the Emphasis scale, calculated using eta squared, was 0.01.

To tell clearly which group mean(s) was/were significantly different, it was necessary to carry out a post-hoc analysis of the F-test results. To this end, the post hoc (Tukey’ post hoc) test was applied to perform multiple comparisons. The results are presented in Table 6.

As depicted in Table 6, the Post-hoc comparisons using the Tukey HSD test indicated that the mean score for biology teachers (M = 2.97, SD = 1.09) on the perceived practice of Emphasis scale was significantly different from Physics teachers (M = 2.62, SD = 1.09). However, chemistry teachers (M = 2.73, SD = 0.40) did not differ significantly from either biology teachers or physics teachers for the Emphasis scale. The descriptive statistics indicated that the perceived practice of teachers for the Emphasis scale was found to be low in all science subjects.

3.4.2. Teachers’ Self-Perceived Practice of CTL based on years of teaching experience
A one-way between-groups analysis of variance was conducted to explore the impact of teachers’ years of teaching experience on the levels of teachers’ perceived practice of CTL. When all four scales were placed as dependent variables, and the teachers teaching experience as the

| Table 9. Comparing teachers’ perceived practice of CTL based on school location |
| --- |
| **Scale** | **Location** | **N** | **Mean** | **SD** | **df** | **t** | **Sig. (2-tailed)** | **Effect Size** |
| Context handling | Urban | 255 | 3.0719 | 0.38 | 358 | 0.853 | 0.39 |
| Rural | 105 | 3.0333 | 0.39 | | | | |
| Regulation | Urban | 255 | 3.1529 | 0.38 | 358 | -1.464 | 0.15 |
| Rural | 105 | 3.2917 | 0.79 | | | | |
| Emphasis | Urban | 255 | 2.8471 | 1.12 | 358 | 1.199 | 0.23 |
| Rural | 105 | 2.7037 | 0.99 | | | | |
| Re-designing | Urban | 255 | 3.2102 | 0.78 | 358 | 2.24 | 0.02 | 0.01 |
| Rural | 105 | 3.021 | 0.7027 | | | | |
independent variable, statistically significant difference was observed only on the teachers’ Re-
designing perceived practice ($F_4, 355) = 5.34, P < 0.05$). The data of this scale also exhibited that
the teaching experience of respondents on Re-designing practice was found to have an effect size
of 0.04. This value (0.04) according to Cohen’s et al. (2005) guideline indicates nearly a moderate
effect. However, no statistically significant difference was observed in the remaining scales (con-
text-handling, regulation, and emphasis).

As shown in Table 8, respondents who taught within the service categories of below 5 years
were compared to the remaining groups. Accordingly, the results of the post-hoc test revealed that
the first significant difference ($p < 0.05$) was found between the respondents within the service
categories of 6–10 years who had relatively high mean score ($M = 3.23$) and those within the
service categories of below 5 years who had low mean score ($M = 2.84$) on Redesigning perceived
practice scale (see Table 7).

The second statistical mean difference was found between the respondents within the service
categories of 16–20 years who had a mean score of ($M = 3.21$) and those within the service
categories of below 5 years who had a low mean score ($M = 2.84$) on Redesigning perceived
practice scale (see Table 7). Moreover, the third statistical mean difference was found between the
respondents within the service categories of above 20 years who had high mean score ($M = 3.33$)
and those within the service categories of below 5 years who had low mean score ($M = 2.84$) on
Redesigning perceived practice scale (see Table 7). The mean scores implied that currently
employed novice science teachers (those who taught below 5 years) had the lowest experience
of adopting their respective science subjects during classroom instruction in the upper primary
schools.

3.4.3. Teachers’ self -perceived Practice of CTL based on school location
The third line of comparison in this study was to examine the differences in teachers’ perceived
practice on the components of CTL based on school location (urban versus rural). To this effect, an
independent sample t-test was performed. The results of the computation are depicted in Table 9
below.

Table 9 presents the means and t-values for each of the four components of CTL and the effect
size (eta-squared) statistic for the Re-designing scale. As depicted in the table, there was
a statistically significant difference in the mean scores of urban science teachers ($M = 3.21$,
SD = 0.78) and rural science teachers ($M = 3.02$, SD = 0.70) in the Redesigning perceived practice
scale ($t = 2.24$, df = 358; $p < 0.05$). However, its effect size (i.e., 0.01) was very small, indicating that
there was a very small difference between urban and rural science teachers in their re-designing
practice of CTL. On the other hand, the t-test mean difference results between urban and rural
tested at alpha 0.05 levels of significance were not statistically significant for Context-handling,
Regulation and Emphasis components (i.e., $t = 0.853$, df = 358, $p > 0.05$, $t = -1.464$, df = 358,
$p > 0.05$ and $t = 1.199$, df = 358, $p > 0.05$, respectively) of teachers’ CTL perceived practice.

Furthermore, multivariate analysis of variance (MANOVA) was employed in the present study for
the reason that the analysis includes more than one related dependent variable (context-handling,
regulation, emphasis, and re-designing). The independent variables were subject areas, experi-
ence, and school location. Preliminary assumption testing was conducted to check for normality,
linearity, univariate and multivariate outliers, homogeneity of variance-covariance matrices, and
multicollinearity. Since the assumptions of MANOVA were not totally satisfied, Pillai’s Trace was
used.

The results of multivariate tests revealed that there was a statistically significant difference
among teachers’ years of teaching experience on the combined dependent variables, $F (4,$
$328) = 1.776, p = 0.029$; Pillai’s Trace = 0.084; partial eta squared = 0.021 (see Table 11). Moreover,
there was also a statistically significant difference between the interaction effect of
subject areas and years of teaching experience on the combined dependent variables, F (32, 1324) = 1.461, p = .047; Pillai’s Trace = 0.136; partial eta squared = .034 (see Table 12). When the results for the dependent variables were considered separately, the only difference to reach statistical significance, using a Bonferroni adjusted alpha level of .013, was re-designing perceived practice of CTL based on their years of teaching experiences, F (4, 331) = 4.448, p = 0.002, partial eta squared = .05. An inspection of the mean scores indicated that a group of teachers who had more than 20 years of teaching experience reported the highest level of perceived re-designing practice (M = 3.33, SD = 0.75) than other groups (see Table 7).

4. Discussion
The current study examined science teachers’ self-perceived practices of CTL in the upper primary science classrooms using an adapted and validated Context-Based Learning Environment in Science (CBLES) instrument. Analyses were made to determine the validity and reliability of the CBLES in terms of its factor structure, internal consistency reliability, and discriminant validity. The results of factor analysis unveiled the confirmation of the four-factor structure (context handling, regulation, emphasis, and redesigning) of the instrument. The reliability and validity results of this study (see Tables 2 & 3) confirmed that the adapted Context-Based Learning Environment in Science (CBLES) scale was found to be a reliable and valid instrument for measuring the teachers’ self-perceived practice of context-based approach in the Ethiopian upper primary science classrooms. The adapted instrument is therefore more or less similar to the original CBLES developed by De Putter-Smits et al. (2013) in terms of both internal consistency and validity. The results suggest that the adapted instrument can provide useful and reliable information that helps teachers, school leaders, researchers, and practitioners to have a thorough understanding of teachers’ perceptions regarding the implementation of the context-based approach in the science classrooms. Besides, the instrument could be used by the Ethiopian science teachers and researchers to conduct further investigation leading to improvements in science context-based classroom environments and consequently students’ achievement in science.

When the upper primary school science teachers’ perceptions on their practices of context-based teaching and learning approach were analyzed, the overall results indicated that the teachers perceived themselves as implementing the CTL approach in science classrooms “sometimes”. This shows that many science teachers tend to teach their respective science subjects in a more traditional content-oriented approach, rather than in a context-based science teaching approach. This result is consistent with what Oloruntegbe et al. (2011) have reported. A comparative evaluation study of contextualization of science among teachers of Malaysian and Nigerian was done to ascertain how well the teachers connect science to the real life of students. The finding showed that a large proportion of the respondents could not contextualize science in their classrooms. Similarly, King (2012) reported that despite extensive evidence from a literature review that context-based approach increases students’ interest, motivation, and conceptual understanding, it is still not used in the majority of science classrooms. Furthermore, the results of previous studies (e.g., Bennett et al., 2007; Fensham, 2009; Lyons, 2006; Sheldrake et al., 2017) justified that the experience of teachers in teaching science through traditional, decontextualized approach might be manifested based on their perception that students need some content knowledge of the body of facts, concepts, principles, laws, and theories of science before they can deal with problems related to real-life situations. The results, therefore, call for further mechanisms to enhance the competences of teachers so as to effectively implement context-based science teaching and learning in the classroom. In this respect, Ültay and Çalıka (2012) suggests that teachers need to be trained in this area.

The Ethiopian upper primary science teachers’ inadequate utilization of the CTL approach and their inclination to the traditional concept-based approach might be associated with several problems. Perhaps, one of the critical problems is that teachers were not involved in the process of making science curriculum materials. In Ethiopia, particularly in the Amhara region, which was the focus of this study, the working science textbooks and teachers’ guides for upper primary
grade levels (grades 7 and 8) were determined by experts at the national level, and the curriculum development process seems to have failed to involve the participation of implementers, mainly teachers. In this situation, as Van Driel, Beijaard, and Verloop (2005) put it, the role of teachers in such situations is perceived as “executing” the innovative ideas of others (policymakers and curriculum designers), which might lead teachers not to implement an innovation exactly the way it was originally planned and described in curriculum materials (Fullan, 2007). Thus, involving teachers in the curriculum development process will make them more willing to accept the innovation (context-based science education), to show their effort of making the curriculum materials well suited to the classroom, and even be able to show a sense of responsibility and ownership as well as to enhance their teaching competences (Bennett et al., 2010).

As already mentioned earlier, in this study, the teachers’ self-perceived practices were analyzed in the competence components of context-handling, regulation, emphasis, and re-designing. Among the four components, the highest mean score was obtained for the regulation component indicating that during the context-based science teaching and learning classrooms, students had the opportunities to explain and justify their ideas to other students, to talk with other students about how to solve context-based problems, and to ask other students to explain their ideas. This is critical because it places the students at the center of the instructional process, and encourages them to actively participate in the learning process. Contrary, the teachers perceived themselves as having the lowest practical experience of addressing the underlying assumptions of emphasis component during context-based science teaching in their classrooms. The findings reveal that in upper primary science classrooms, teachers are unable to give opportunities for students to conduct context-based inquiries and to understand how knowledge evolves and is culturally and socially driven. Perhaps, this problem would possibly be manifested due to the reason that teachers might lack appropriate competences in addressing CTL through investigation and experimental methods in the classroom. In such context-related investigation and experimental activities, teachers are expected to be consistent with the cultural values of the students and society. Accomplishing such competences in the context of Ethiopian upper primary schools might be challenging because recent studies disclose that the Ethiopian science classroom practices have been entangled with many problems such as lack of equipment and resources, poorly organized laboratories, lack of teachers’ competence and motivation to involve students in practical activities, fear of teachers to carry out experimental activities, inadequate time allotment for practical lab work, and lack of on-job training to support science teachers (Ayicheh, 2020; Chala, 2019; Daba & Anbesaw, 2016; Negasso, 2014).

Teachers’ self-perceived practice of CTL based on their subject areas was the other variable examined in this study. According to the results of the one-way ANOVA, there was a statistically significant difference between teachers’ perceptions of CTL’s practices in addressing the emphasis component in the classroom based on subject areas. As a result, biology teachers’ perceptions in addressing the emphasis component of CTL were better than physics teachers. However, the overall results show that teachers are not in a position to provide opportunities for students to carry out investigations and to experience that knowledge is evolving and is culturally and socially determined (i.e. Uncertainty) in the upper primary science classrooms. This finding is congruent with previous research conducted by De Putter-Smits et al. (2013), which revealed that there was a significant difference between the science subjects on the emphasis component with F(3, 84) = 3.32, p < 0.05, ω² = 0.073.

Recently, the focus of science education has been on how to adapt the curriculum to students’ interests and experiences in order to improve students’ understanding of the relevance of science to their daily lives (Tzou & Bell, 2010). Although science teachers need to use curriculum materials flexibly, the effectiveness of adaptations to their curriculum can vary. (e.g., Fogleman et al., 2011). When the teachers’ perceived practices of CTL based on experience were analyzed, the results of the study depicted that there was a statistically significant difference among teachers in the re-designing component of CTL perceived practices based on years of teaching experience. Upper
Primary school science teachers with more than twenty years of teaching experience were found to have a better experience of redesigning/adapting science curricular materials than others. Teachers perceived themselves as being more likely to adjust science curriculum materials based on resource availability and personal life experiences of students. This is consistent with other studies in which it was found that experienced science teachers have the skills necessary to actually create and adapt a context-based learning environment than novice teachers (Rodriguez, 2012; Unianu, 2012; Vos et al., 2010). Since beginning teachers tend to rely heavily on curriculum materials to meet the challenges of effective teaching, they are unlikely to adapt curriculum materials (Valencia et al., 2006). On the other hand, the findings of Suprayogi et al. (2017) found out that teachers with more than 20 years of experience are more likely to resist changes and criticize modifying the existing curricular materials whereas teachers with five years or less experience seem to be more eager to adopt innovation.

The descriptive statistics showed that science teachers in urban upper primary schools perceived themselves as practicing the redesigning component of CTL more frequently (M = 3.21, SD = 0.78) than science teachers in rural upper primary schools (M = 3.02, SD = 0.70), with a small effect size (i.e., 0.01). Because statistically significant differences were present in the Redesigning perceived practice scale (t = 2.24, df = 358; p < 0.05) of this study, it is possible to infer that perceived frequency of practice of redesigning/adaptation of curricular materials in science is influenced by urban/rural classification. Prior research by Lucero et al. (2013) suggested that science teachers in urban schools differ in their perceptions of teaching and learning from science teachers in rural schools. The researchers found that science teachers in rural schools are more likely to approach teaching and learning from a didactic, decontextualized approach, whereas science teachers in urban schools are more likely to approach teaching and learning from a more constructivist, context-based approach. Unfortunately, there does not exist much literature that yields empirical results which can directly be compared with this finding. Thus, while this study does not directly support the aforementioned finding, the findings of this study do support their claim that teachers differ in their perceptions based on urban/rural classification.

5. Conclusions and implications
Despite the issue of curriculum contextualization in sciences is vividly addressed in the Ethiopia upper primary science curricula, the extent of teachers’ practices of context-based teaching and learning approach in the science classroom was found to be insufficient. This implies that the teaching-learning process of science was highly dominated by traditional content-oriented than constructivist context-based approach, which is incompatible with primary education policy, science curriculum framework, and, even, with the reform of primary teacher education program (Ministry of Education, 2009; Ministry of Education, 2017). In comparison, biology teachers' level of practicing the emphasis component; and experienced teachers' and urban teachers' level of practicing the re-designing component of CTL were fairly found to be in a better way than their counterparts. Thus, such findings could have some important implications for teachers to revisit their practices of CTL and to reconsider the values of context-based approach into their continuous professional development (CPD) program. Besides, the Amhara Education Bureau, district education offices, upper primary schools, and the nearby teacher education institutions could get some insights on the results of the study so that they can devise appropriate mechanisms (e.g., training of teachers in the form of workshops and seminars) to improve teachers’ competences of teaching science through the context-based approach.

Current literature suggests that context-based science teaching and learning could be successfully implemented in the classroom if teachers possess the required competences of contextual handling, regulation, emphasis, and re-designing (De Putter-Smits et al., 2013). However, studies conducted in relation to such competences were very limited. This research, therefore, hopes to contribute to the growing literature of current literature on context-based science education from the perspective of teachers. The validation of an instrument to measure teachers’ self-perceived practice of CTL provides an important input tool for teachers, teacher educators, and researchers in
Ethiopia, and possibly elsewhere. Furthermore, examining teachers' self-perceived practice of CTL in light of their subject areas, years of teaching experience and school location is desirable to strengthen the current literature on context-based science teaching and learning.

6. Limitations
The study was constrained by several factors. First, the Coronavirus disease (COVID 19) pandemic in Ethiopia, like the other part of the world, impeded us from observing the teachers’ actual CTL practices in the science classrooms, which could have provided firsthand information about science teachers’ actual implementation of CTL in their classrooms. It was also limited by the method of sample selection because the teachers were selected only from governmental upper primary schools from one administrative zone in the Amhara region, Ethiopia. Therefore, the results of this study cannot be generalized beyond the context of the participating upper primary schools in the selected East Gojam administrative zone.

Funding
The authors received no direct funding for this research.

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Citation information
Cite this article as: Context-based teaching and learning practices in upper primary science classrooms in East Gojam administrative Zone, Ethiopia. Gebyew Teshager, Alemayehu Bishaw & Asrat Dagnew, Cogent Education (2021), 8: 1940635.

References
Acar, B., & Yaman, M. (2011). The effects of context-based learning on students’ levels of knowledge and interest. Hacettepe University Journal of Education, 40, 1–10.
Aikenhead, G. S. (2006). Science education for everyday life: Evidence-based practice. Teachers College Press.
Asabere-Arneyaw, A., Dei, G. J. S., & Raheem, K. (2012). The question of indigenous science and science education. Contemporary Issues in African Sciences and Science Education, 15–28. https://doi.org/10.1007/978-94-6091-702-8_2
Ayyicheh, A. S. (2020). Status of chemistry laboratory and practical activities in secondary and preparatory schools of East Gojam, Ethiopia. Chemical and Process Engineering Research, 63, 9–14. https://doi.org/10.17176/cper/63-02
Baker, E. D., Hope, L., & Karandjief, K. (2009). Contextualized teaching and learning: A faculty primer. A review of literature and faculty practices with implications. Centre for Student Success: California Community College. https://files.eric.ed.gov/fulltext/ED519284.pdf
Bartlett, M. S. (1956). A note on the multiplying factors for various chi square approximations. Journal of the Royal Statistical Society, 16(Series B), 296–298.
Basu, S. J., & Barton, A. C. (2007). Developing a sustained interest in science among urban minority youth. Journal of Research in Science Teaching, 44(3), 466–489. https://doi.org/10.1002/tea.20143
Bellocci, A., King, D. T., & Ritchie, S. M. (2016). Context-based assessment: Creating opportunities for resonance between classroom fields and societal fields. International Journal of Science Education, 38(8), 1304–1342. https://doi.org/10.1080/09500693.2016.1189107
Bennett, J., Gräsel, C., Parchmann, I., & Waddington, D. (2005). Context-based and conventional approaches to teaching chemistry: Comparing teachers’ views. International Journal of Science Education, 27(13), 1521–1547. https://doi.org/10.1080/09500690500153808
Bennett, J., Hogarth, S., Lubben, F., Campbell, B., & Robinson, A. (2010). Talking science: The research evidence on the use of small group discussions in science teaching. International Journal of Science Education, 32(1), 69–95. https://doi.org/10.1080/09500690802713507
Bennett, J., Lubben, F., Hogarth, S., Verbeke, K., Decuyper, E., & Buyse, J. (2007). Bringing science to life: A synthesis of the research evidence on the effects of context-based and STS approaches to science teaching. Journal of Animal Physiology and Animal Nutrition, 91(7–8), 347–370. https://doi.org/10.1111/j.1439-0396.2006.00661.x
Brown, T. A. (2006). Confirmatory factor analysis for applied research. Guildford Press.
Chala, A. A. (2019). Practice and challenges facing practical work implementation in natural science subjects at secondary schools. Journal of Education and Practice, 10 (31), 1–17. https://doi.org/10.7176/jep/10-31-01
Chen, J., & Cowie, B. (2013). Engaging primary students in learning about new zealand birds: A socially relevant context. International Journal of Science Education, 35(8), 1344–1366. https://doi.org/10.1080/09500693.2012.763194
Cohen, L., Manion, L., & Morrison, K. (2005). Research Methods in Education (5th Ed.). London: Routledge Falmer
Creswell, J. W. (2009). Research design: Qualitative, quantitative and mixed methods approaches. Sage Publications, Inc.
Dabo, T. M., & Anbesaw, M. S. (2016). Factors affecting implementation of practical activities in science education in some selected secondary and preparatory schools of Afar Region, North East Ethiopia. International Journal of Environmental and Science Education, 11(12), 5438–5452.
De Jong, O. (2008). “Context-based chemical education: How to improve it?”. Chemical Education International, 8(1), 1-7. June, 2019, http://old.iupac.org/publications/cevol9/index.html
De Putter-Smits, L. G. A., Topanis, R., & Jochems, W. M. G. (2013). Mapping context-based learning environments: The construction of an instrument. 437–462. https://doi.org/10.1007/s10984-013-9143-9
De Vaus, D. A. (2004). Surveys in Social Research (5th ed.). Routledge.

Dewey, J. (1916). Democracy and education: An introduction to the philosophy of education. Macmillan.

Eshetu, F., & Assefa, S. (2019). Effects of context-based instructional approaches on students’ problem-solving skills in rotational motion. 15(2).

Fensham, P. J. (2009). Real world contexts in PISA science: Implications for context-based science education. Journal of Research in Science Teaching: The Official Journal of the National Association for Research in Science Teaching, 46(8), 884–896. https://doi.org/10.1002/tea.20334

Fernandes, P., Leite, C., Mouraz, A., & Figueiredo, C. (2013). Curricular contextualization: Tracking the meanings of a concept. The Asia-Pacific Education Researcher, 22(4), 417–425. https://doi.org/10.1007/s40299-012-0041-1

Fogelman, J., McNell, K. L., & Krijgcj, J. S. (2011). Examining the effect of teachers’ adaptations of a middle school science inquiry-oriented curriculum unit on student learning. Journal of Research in Science Teaching, 48(2), 149–169. https://doi.org/10.1002/tea.20399

Fullan, M. (2002). The new meaning of educational change (4th ed.). Teachers College Press.

Gercke, C., & Ozcan, O. (2015). Views of biology teacher candidates about context based approach. Procedia - Social and Behavioral Sciences, 197(Febraury), 810–814. https://doi.org/10.1016/j.sbspro.2015.07.190

Gilbert, J., Bulte, A., & Pilot, A. (2013). Concept development and transfer in context-based science education. International Journal of Science Education, 33(6), 817–837. https://doi.org/10.1080/09500693.2010.493185

Gilbert, J. K. (2006). On the nature of “context” in chemical education. International Journal of Science Education, 28(9), 957–976. doi:10.1080/0950069060072470hal-00513318

Hartnell-Young, E., & Vetere, F. (2008). A means of personalisation learning: Incorporating old and new literacies in the curriculum with mobile phones. The Curriculum Journal, 19(4), 283–292. https://doi.org/10.1080/09500690500339621

Kaiser, H. (1970). A second generation Little Jiffy. Psychometrika, 35(4), 401–415. https://doi.org/10.1007/BF02291817

Kazemi, M., & Onwu, G. (2013). Comparative effectiveness of context-based and traditional approaches in teaching genetics : Student views and achievements. 17, 50–62. https://doi.org/10.1080/10288457.2013.826970

King, D. (2007). Teacher beliefs and constraints in implementing a context-based approach in chemistry. Teaching Science: The Journal of the Australian Science Teachers Association, 53(1), 14–18.

Kling, D., & Ritchie, S. (2012). Learning science through real-world contexts. In B. Fraser, K. Tobin, & C. McRobbie (Eds.), Second international handbook of science education (pp. 69–77). Springer. https://doi.org/10.1007/978-1-4020-9041-7_6

King, D. (2012). New perspectives on context-based chemistry education: Using a dialectical sociocultural approach to view teaching and learning. Studies in Science Education, 48(1), 51–87. https://doi.org/10.1080/03057276.2012.655037

King, D. (2016). Teaching and learning in context-based science classes: A dialectical sociocultural approach. In R. Taconis, P. Den Brok, & A. Pilot (Eds.), Teachers Creating Context-Based Learning Environments (pp. 71–85). Sense Publishers.

Leite, C., Fernandes, P., & Figueiredo, C. (2018). Challenges of curricular contextualization: Teachers’ perspectives. The Australian Educational Researcher, 45(4), 435–453. https://doi.org/10.1080/1338018-018-0271-6

Lucero, M., Valcke, M., & Schellens, T. (2013). Teachers’ beliefs and self-reported use of inquiry in science education in public primary schools teachers’ beliefs and self-reported use of inquiry in science education in public primary schools. September 2013, 37–41. https://doi.org/10.1080/09500693.2012.704430.

Lyons, T. (2006). Different countries, same science classes: Students’ experiences of school science in their own words. International Journal of Science Education, 28(6), 591–613. https://doi.org/10.1080/09500690500339621

Macedo, E. (2013). Equity and difference in centralized policy. Journal of Curriculum Studies, 45(1), 28–38. https://doi.org/10.1080/00220272.2012.754947

Ministry of Education. (2002). The Education and Training Policy and Its Implementation. Addis Ababa: Berhanenaa Selam Printing Press.

Ministry of Education (2009). Curriculum framework for ethiopian education (KG-Grade 12).

Ministry of Education (2005). The federal democratic republic of ethiopia education sector development program Three (ESDP III): 2005/06-2010/11Program Action Plan.

Ministry of Education. (2017). Ethiopian Education Development Roadmap: An Integrated executive summary (draft). Ministry of Education.

Msimanga, A., & Shizha, E. (2014). Indigenous knowledge and science education in South Africa. Remapping Africa in the Global Space, 137–150. https://doi.org/10.1007/978-94-6209-836-7_10

Negassa, O. (2014). Ethiopian students’ achievement challenges in science education: Implications to policy formulation. African Journal of Chemical Education, 4(1), 2–18.

Oloruntegbe, K. O., Alam, G. M., Nural, S., Syed, A., Okwun, C. K., Robby, T. G., & Kareem, S. D. (2011). Contextualization of science knowledge : A case study of Malaysian and Nigerian serving and pre-service teachers. 6(8), 2169–2174.

Osioma, I. U. (2017). Aficanizing science education: Engaging students in context-based science instruction. Challenges Associated with Cross-Cultural and Risk Student Engagement. 120–127. https://doi.org/10.4189/178-5225-1894-5.ch007

Ottevanger, W., Folmer, E., & Kuiper, W. (2016). ‘Context-based science education in senior secondary schools in the netherlands: Teachers’ perceptions and experiences. In R. Taconis, P. Den Brok, & A. Pilot (Eds.), Teachers Creating Context-Based Learning Environments (pp. 213–233). Sense Publishers.

Parchmann, I., Gräsel, C., Boer, A., Nentwig, P., Demuth, R., Rolle, B., & Parchmann, I., Grasel, C., Boer, A., Nentwig, P., Demuth, R., Rolle, B., and the CHIK project group. (2006). “Chemie im Kontext”: A symbiotic implementation of a context-based teaching and learning approach. International Journal of Science Education, 28(9), 1041–1062. https://doi.org/10.1080/09500690600725122

Pilot, A., & Bulte, A. M. W. (2006). Why do you “need to know”? Context-based education. International Journal of Science Education, 28(9), 953–956. https://doi.org/10.1080/09500690600702462

Podschewski, S., & Bernholt, S. (2018). Composition-effects of context-based learning opportunities on students’ understanding of energy. Research in
Priestley, M. (2010). Curriculum for excellence: Transformational change or business as usual? Scottish Educational Review, 42(1), 23–36.

Prins, G. T., Bulte, A. M., & Pilot, A. (2018). Designing context-based teaching materials by transforming authentic scientific modelling practices in chemistry. International Journal of Science Education, 40(10), 1108–1135. doi:10.1080/09500693.2018.1470347

Rodrigues, A. (2012). Analysis of elementary school teachers’ knowledge and use of differentiated instruction. (Unpublished Ed.D. Dissertation). Illinois. Olivet Nazarene University

Savelsbergh, E. R., Prins, G. T., Rietbergen, C., Fechner, S., Voessen, B. E., Draijer, J. M., & Bakker, A. (2016). Effects of innovative science and mathematics teaching on student attitudes and achievement: A meta-analytic study. Educational Research Review, 19, 158–172. doi:10.1016/j.edurev.2016.07.003

Sheildrake, R., Mujtaba, T., & Reiss, M. J. (2017). Science teaching and students’ attitudes and aspirations: The importance of conveying the applications and relevance of science. International Journal of Educational Research, 85, 167–183. doi:10.1016/j.ijer.2017.08.002

Stanisavljević, J. D., Pejčić, M. G., & Stanisavljević, L. Z. (2016). The application of context-based teaching in the realization of the program content: “the decline of pollinators.”. 1(1), 51–63. doi:10.5281/zenodo.55476

Suprayogi, M. N., Valcke, M., & Godwin, R. (2017). Teachers and their implementation of differentiated instruction in the classroom. Teaching and Teacher Education, 67, 291–301. doi:10.1016/j.tate.2017.06.020

Tabor, K. S. (2017). The use of cronbach’s alpha when developing and reporting research instruments in science education. Research in Science Education. doi:10.1007/s11165-016-9602-2

Tyler, R. (2007). Re-imagining science education: Engaging students in science for Australia’s future (Australian Council for Educational Research). ACER Press.

Tzou, C. T., & Bell, P. (2010). Micros and Me: Leveraging home and community practices informal science instruction. In K. Gomez, L. Lyons, & J. Rodinsky (Eds.), Proceedings of the 9th International Conference of the Learning Sciences (pp. 1135–1143). Chicago, IL: International Society of the Learning Sciences. doi:10.2318/icts2010.1.1135

Ülütay, N., & Çalık, M. (2012). A thematic review of studies into the effectiveness of context-based chemistry curricula. Journal of Science Education and Technology, 21(6), 686–701. doi:10.1007/s10956-011-9357-5

Unianu, E. M. (2012). Teachers’ attitudes towards inclusive education. Procedia - Social and Behavioral Sciences, 33, 900–904. doi:10.1016/j.sbspro.2012.01.252

Valencia, S. W., Place, N. A., Martin, S. D., & Grossman, P. L. (2006). Curriculum materials for elementary reading: Shackles and scaffolds for four beginning teachers. The Elementary School Journal, 107(1), 93–120. doi:10.1086/509528

Van Den Akker, J. (2004). Curriculum Perspectives: An Introduction. Curriculum Landscapes and Trends, 1–10. doi:10.1007/978-94-017-1205-7_1

Van Driel, J., Beijaard, D., & Verloop, N. (2005). Professional development and reform in science education: the role teachers’ practical knowledge. Journal of research in science teaching, 381, 137–158. doi:10.1002/1098-2736(200102)38:2<37::aid-tea 1001>3.0.CO;2-U

Vogelzang, J., Amiralow, W. F., & Von Driel, J. H. (2019). Scrum methodology as an effective scaffold to promote students’ learning and motivation in context-based secondary chemistry education. Eurasia Journal of Mathematics, Science and Technology Education, 15(12). doi:10.29333/ejmste/109941

Vos, M., Taconis, R., Jochems, W., & Pilot, A. (2010). Teachers implementing context-based teaching materials: A framework for case-analysis in chemistry. Chemistry Education Research and Practice, 11(3), 193–206. doi:10.1039/c005468M

Walan, S. (2016). From doing to learning: Inquiry- and context-based science education in primary school Unpublished PhD dissertation, Karlstad University.

Walan, S., Ewen, B. M., & Gericke, N. (2016). Enhancing primary science: An exploration of teachers’ own ideas of solutions to challenges in inquiry- and context-based teaching, 4279(Feburary). doi:10.1080/03004279.2015.1092456.

Wieringa, N., Janssen, F. J. J. M., & Van Driel, J. H. (2011). Biology teachers designing context-based lessons for their classroom Practice—The importance of rules-of-thumb. International Journal of Science Education, 33(17), 2437–2462. doi:10.1080/09500693.2011.553969

Yu, K. C., Fan, S. C., & Lin, K. Y. (2015). Enhancing students’ problem-solving skills through context-based learning. International Journal of Science and Mathematics Education, 13(6), 1377–1401. doi:10.1007/s10763-014-9567-4

Zimmerman, B. J., & Schunk, D. H. (2001). Self-regulated learning and academic achievement: Theoretical perspectives. Erlbaum. USA.
Appendix 1

| Scale               | Scale description                                                                 | Sample items                                                                 |
|---------------------|-----------------------------------------------------------------------------------|-------------------------------------------------------------------------------|
| Context-Handling    | The extent to which science teachers are capable of presenting the context in science curriculum material effectively to the students everyday lives | In my class: I use a variety of students’ everyday experiences to explain scientific concepts. |
| Regulation          | The extent to which science teachers are involving students in the design, delivery, and assessment of CTL practice, and the degrees to which students could interact and speak to each other in the classroom as a function of context-based learning. | I request students to decide how well they are learning during context based science instruction |
| Emphasis            | The extent to which students learn how knowledge in science is developed in socio-historical contexts, so that they learn to see science as a culturally determined system of knowledge, which is constantly developing. | I make students learn that context based science learning is influenced by people's cultural values and opinions |
| Re-designing        | The extent to which teachers are adapting science curriculum to personal, social and environmental, professional as well as technological dimensions | I adapt science materials to community and environmental issues during classroom teaching |

Source: De Putter-Smits et al. (2013); De Jong (2008)
Appendix 2

Table 11. The Summary of MANOVA results for the main effects and interaction effects of school location, subject areas and years of teaching experiences on components of CTL practices

| Effect                  | Pillai’s Trace Value | F   | Hypothesis df | Error df | Sig. | Partial Eta Squared |
|-------------------------|----------------------|-----|---------------|----------|------|---------------------|
| Location                | .002                 | .163 | 4.000         | 328.000  | .957 | .002                |
| Subject                 | .024                 | .985 | 8.000         | 658.000  | .447 | .012                |
| Experience              | .084                 | 1.776 | 16.000       | 1324.000 | .029 | .021                |
| Location * Subject      | .030                 | 1.256 | 8.000         | 658.000  | .264 | .015                |
| Location * Experience   | .062                 | 1.313 | 16.000       | 1324.000 | .180 | .016                |
| Subject * Experience    | .136                 | 1.461 | 32.000       | 1324.000 | .047 | .034                |
| Location * Subject * Experience | .070                 | .844 | 28.000       | 1324.000 | .700 | .018                |

*p < 0.05

(Continued)

Table 12. The Summary of MANOVA results for tests of between-subject effects on the components of CTL with reference to respondents’ demographic characteristics (n = 360)

| Source                  | Dependent Variables | Type III Sum of Squares | df | Mean Square | F   | Sig. | Partial Eta Squared |
|-------------------------|---------------------|-------------------------|----|-------------|-----|------|---------------------|
| Location                | Context handling    | 1.58E-07                | 1  | 1.58E-07    | 0.000 | 0.999 | 0.000               |
|                         | Regulation          | 0.233                   | 1  | 0.233       | 0.328 | 0.567 | 0.001               |
|                         | Emphasis            | 0.073                   | 1  | 0.073       | 0.064 | 0.801 | 0.000               |
|                         | Re-designing        | 0.134                   | 1  | 0.134       | 0.24  | 0.625 | 0.001               |
| Subject                 | Context handling    | 0.296                   | 2  | 0.148       | 0.979 | 0.377 | 0.006               |
|                         | Regulation          | 1.116                   | 2  | 0.558       | 0.784 | 0.458 | 0.005               |
|                         | Emphasis            | 2.845                   | 2  | 1.422       | 1.251 | 0.288 | 0.007               |
|                         | Re-designing        | 0.402                   | 2  | 0.201       | 0.36  | 0.698 | 0.002               |
| Experience              | Context handling    | 0.428                   | 4  | 0.107       | 0.707 | 0.587 | 0.008               |
|                         | Regulation          | 2.255                   | 4  | 0.564       | 0.792 | 0.531 | 0.009               |
|                         | Emphasis            | 3.751                   | 4  | 0.938       | 0.825 | 0.510 | 0.010               |
|                         | Re-designing        | 9.936                   | 4  | 2.484       | 4.448 | 0.002 | 0.051               |
| Location * Subject      | Context handling    | 0.290                   | 2  | 0.145       | 0.959 | 0.384 | 0.006               |
|                         | Regulation          | 5.057                   | 2  | 2.528       | 3.552 | 0.030 | 0.021               |
|                         | Emphasis            | 0.264                   | 2  | 0.132       | 0.116 | 0.890 | 0.001               |

(Continued)
Table 12. (Continued)

|                          | Re-designing | 2 | 0.070 | 0.125 | 0.883 | 0.001 |
|--------------------------|--------------|---|-------|-------|-------|-------|
| Location * Experience    | Context handling | 0.629 | 4 | 0.157 | 1.04 | 0.387 | 0.012 |
| Regulation               | 1.359 | 4 | 0.340 | 0.477 | 0.752 | 0.006 |
| Emphasis                 | 8.602 | 4 | 2.151 | 1.891 | 0.112 | 0.022 |
| Re-designing             | 4.192 | 4 | 1.048 | 1.876 | 0.114 | 0.022 |
| Subject * Experience     | Context handling | 1.836 | 8 | 0.230 | 1.519 | 0.149 | 0.035 |
| Regulation               | 4.009 | 8 | 0.501 | 0.704 | 0.688 | 0.017 |
| Emphasis                 | 13.258 | 8 | 1.657 | 1.457 | 0.172 | 0.034 |
| Re-designing             | 8.676 | 8 | 1.085 | 1.942 | 0.053 | 0.045 |
| Location * Subject * Experience | Context handling | 0.516 | 7 | 0.074 | 0.488 | 0.843 | 0.010 |
| Regulation               | 4.873 | 7 | 0.696 | 0.978 | 0.447 | 0.020 |
| Emphasis                 | 9.432 | 7 | 1.347 | 1.185 | 0.311 | 0.024 |
| Re-designing             | 2.748 | 7 | 0.393 | 0.703 | 0.670 | 0.015 |
| Error                    | Context handling | 50.022 | 331 | 0.151 |
| Regulation               | 235.626 | 331 | 0.712 |
| Emphasis                 | 376.449 | 331 | 1.137 |
| Re-designing             | 184.853 | 331 | 0.558 |
| Corrected Total          | Context handling | 3795.16 | 360 |
| Regulation               | 54.481 | 359 |
| Emphasis                 | 260.55 | 359 |
| Re-designing             | 423.197 | 359 |
|                         | 211.711 | 359 |
