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Teachers' Perception of Using a Context-Based Approach in Mathematics Instruction

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Abstract

This study aims to investigate teachers' perceptions of the context-based approach (CBA) in mathematics at secondary-level schools. It employed an exploratory qualitative research design, utilizing semi-structured interviews with five purposively selected mathematics teachers from community-based secondary schools in Birendranagar Municipality, Surkhet District, Nepal. The collected data were analyzed using thematic analysis. The findings revealed that teachers perceived the CBA as effective and beneficial for teaching mathematics at the secondary level. Additionally, they demonstrated a theoretical awareness of its principles and applications. However, the study highlighted that teachers were not applying the CBA sufficiently in classroom instruction, indicating a gap between their conceptual understanding and the practical implementation of the approach in mathematics teaching. Based on these findings, the study strongly recommends the design and implementation of the Context-Based Instruction (CBI) approach to enhance academic outcomes in mathematics at the school level in Nepal.

Keywords: Challenges, context-based instruction, mathematics education, teacher perception

Introduction

Mathematics is based on and developed from the context of society and hence it cannot be isolated from the learner's context where students learn meaningfully by connecting real-life examples to the subject content. Teaching within context is crucial for effective mathematics learning (Barnes & Venter, 2008). The context-based approach (CBA) is considered the backbone of a real-life-based teaching-learning process in education (Nyirenda, 2024). The CBA relies on learners' daily life experiences and interests (Aydin-Ceran, 2021), highlighting the relationship between content and its context (Johnson, 2002). This holistic model connects the learning process with students' daily lives, incorporating personal experiences, social issues, and cultural contexts (Al Hakim et al., 2018). Teachers use this approach to link teaching materials with students' familiar personal, social, and cultural contexts in classroom practices (Fatimah et al., 2020).

Moreover, CBA emphasizes students' active participation in learning by using real-life experiences, motivating them to apply their knowledge in everyday activities (Firdaus & Dewi, 2018). Teaching and learning activities are thus closely related to personal, social, and cultural experiences within the CBA strategy. The development of innovative technologies, socio-cultural complexities, and changing perceptions of students and teachers necessitate the adoption of new teaching strategies to make lessons more informative, relevant, and engaging (McAfee, 2012). Traditional teaching approaches have limited ability to connect school knowledge with students' daily life experiences and interests (Karsli & Yigit, 2017). Several studies (Bennett & Lubben, 2006; Drawil et al., 2012; Ellison et al., 2012; King, 2007; Ramsden, 1997) have shown that CBA enhances students' conceptual understanding, engagement, motivation, and academic achievement.

CBA is a teaching framework based on constructivism, allowing learners to connect prerequisite knowledge with newly acquired knowledge (Gunter, 2018). It combines inquiry learning, problem-based learning, cooperative learning, project-based learning, and authentic assessment (Glynn & Koballa, 2005). Reviews of various studies indicate that the REACT strategy is Relating, Experiencing, Applying, Cooperating, and Transferring (Crawford, 2001), and the CBA-5E model is a learning cycle based on Engagement, Exploration, Explanation, Elaboration, and Evaluation (Bybee, 2009, 2014; Bybee et al., 2006) are widely used in education. In Nepal, a CBA model can be developed by integrating the REACT strategy, the 5E learning cycle, and ICT into the mathematics teaching and learning process.

Mathematics is central to education, serving as the foundation for higher education across disciplines. The primary objective of mathematics education is to cultivate students' ability to utilize mathematical knowledge, skills, and concepts in everyday situations (Wijaya et al., 2015). In Nepal, mathematics is a compulsory subject in the school curriculum. The objective is to equip students with the necessary mathematical knowledge, skills, and competencies to solve daily life problems. For meaningful learning, it is essential to interact with teachers, parents, and friends, and to practice and apply mathematical knowledge and skills in various real-life scenarios. Thus, school-level mathematics curricula have demanded that students be able to apply their mathematical concepts in their daily life activities (Curriculum Development Center[CDC], 2078). There is a gap between mathematical concepts and real-life practices (Yildiz & Baltaci, 2016) and CBA connects teaching-learning activities with the real-world context of students (Johnson, 2002). In the context of school-level mathematics, relating mathematics concepts with its context of real-world connections is a challenging issue (Gainsburg, 2008) in the context of Nepal.

Globally, teachers and students have positive perceptions of using CBA in education (Amelia & Niniwati, 2019). Studies in various settings have shown that CBA is applicable in different fields of mathematics (Fatkurochman et al., 2024; Mentari & Syarifuddin, 2020; Reyes et al., 2019; Yunitasari et al., 2023). A few studies conducted in Nepal recommend contextual mathematics learning (Acharya et al., 2021; Khanal et al., 2021; Pradhan, 2019; Roka & Khatri, 2021).

While numerous global studies have shown the effectiveness of the Context-Based Approach (CBA) in enhancing student engagement, motivation, and conceptual understanding in mathematics (Amelia & Niniwati, 2019; Bennett & Lubben, 2006), limited research has focused on teachers' perceptions and the practical implementation of CBA in Nepal. Although some studies recommend contextualized mathematics teaching in Nepal (Acharya et al., 2021; Khanal et al., 2021; Pradhan, 2019), there is a lack of specific research exploring how secondary-level mathematics teachers perceive and apply the CBA. Additionally, the challenges teachers face in implementing CBA in the Nepali context have not been thoroughly investigated. This study addresses this gap by examining teachers' perceptions and the difficulties they encounter in integrating CBA into secondary-level mathematics teaching in Nepal, aiming to contribute to the local understanding and application of this approach. Based on this objective, the study addresses the following research questions:

i) How do teachers perceive the context-based approach in mathematics teaching?
ii) What challenges do teachers perceive in implementing the context-based approach in their teaching practices

Methods

This study adopted a qualitative approach with an exploratory research design (Gungor et al., 2023; Rehman & Alharthi, 2016) to investigate teachers' perceptions of using the Context-Based Approach (CBA) in secondary-level mathematics teaching. We explored participants' multiple perspectives on classroom practices (Creswell & Creswell, 2017) related to the study problem. We believe that the nature of the reality of using CBA in classroom practices, in the context of teachers' beliefs, attitudes, and diverse backgrounds, is subjective (Kamal, 2019; Matta, 2022).

The study was conducted in Birendranagar Municipality, located in the Surkhet district of Karnali Province, Nepal. According to Flash Report (2023), there are 71 secondary schools in Birendranagar Municipality comprising 26 community schools. For this study, five community secondary schools of Birendranagar Municipality were selected purposively. In addition, one secondary-level mathematics teacher with at least five years of teaching experience was purposively selected from each of the selected sampled

schools. For the data collection, an in-depth interview (IDI) was used. The IDI consists of the perception' of teachers towards the use of CBA in mathematics (Makari, 2007; Panthi et al., 2018). The semi-structured interviews were used as IDI guidelines for conducting the interview (Adeoye-Olatunde & Olenik, 2021). The guideline focuses on the concept of CBA, the capacity to use CBA, and difficulties faced by teachers in implementing CBA in mathematics teaching.

The first author established a natural setting and built rapport with participants to explain the research purpose. Interviews were conducted in the Nepali language using prepared guidelines. Each interview lasted approximately one hour and was conducted face-to-face with five participants at their respective schools. The first author recorded the interviews with mathematics teachers using a voice recorder.

We analyzed the collected data using thematic analysis (Flick, 2022). We followed six phases: familiarizing with the data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (Braun & Clarke, 2006). At first, the recorded voices of respondents were transcribed into Nepali. Then the transcriptions were translated into English with the support of an English language expert using ATLAS ti. Twenty-one codes and categories were identified and by merging those categories, two main themes were generated. The authors established a balance between the potential risks of research and the respondents of the study. In this study, the authors have taken informed consent of participants orally. The information of participants has confidentiality been guaranteed by the authors.

Results

The results are primarily examined through two key themes: the perceived understanding of CBA and the perceived challenges in implementing it. The initial codes, categories, and themes are presented in Table 1 and further elaborated in the subsequent sections:

Table 1

Themes, Categories and Initial Codes

Themes	Categories	Initial codes
Perceived Understanding of CBA	Concept of CBA	combination of three aspects; planning, application and evaluating, connecting with experiences, conceptual and sustainable learning
	Connecting with context	Can differing CBA from traditional teaching Contextualize local activities and skills linked mathematics problems with previous knowledge, local teaching materials, culture, and daily life.
	Benefit and redness to use CBA	Experienced using CBA in home arithmetic Experienced using CBA in local materials, ICT, and contents, offering active participation concept perceived benefit

Perceived Difficulties of Implementing CBA	Individual difficulties	Difficult to prepare materials, Lack of knowledge regarding CBA, low opportunity to use CBA Willingness to apply CBA strategies
	institutional difficulties	lack of human resources, a large number of students low classroom management, no ICT-friendly classroom, not insufficient infrastructure
	System based difficulties	lack of teaching materials, magnitude of traditional teaching culture, Time management difficulties

Perceived Understanding of CBA

The overall findings of the study revealed that their perception regarding CBA is adequate. This theme includes three sub-themes such as the concept of CBA, connecting with context and perceived benefit and readiness to use CBA in their classroom.

Concept of CBA

This category includes the code as a combination of three aspects; planning, application and evaluating, connecting with experiences, conceptual and sustainable learning.

The first code illustrated that out of three participants, CBA is a combination of three aspects such as planning, application, and evaluating of teaching approach in mathematics. In this regard, participant T1 shared that , *"Contextual teaching strategy is a teaching approach based on planning, application, and evaluation*". The second code shows that our all participants defined CBA as a teaching-learning process that is connected with the daily life experiences of students to improve their conceptual understanding and sustainable learning in mathematics. In this context, participant T2 stated, *"In my opinion, contextual teaching strategy means teaching by connecting the mathematical contents to the context of daily life experiences of students which improves the students' conceptual understanding and sustainability in learning".* Thus, the Context-Based Approach (CBA) in mathematics education emphasizes connecting mathematical concepts to students' prior knowledge, real-life experiences, and contextual situations. This approach aims to foster a deeper conceptual understanding and enhance students' engagement in learning mathematics.

Connecting with Context

This category includes codes such as CBA can differ from traditional teaching, contextual with local activities and skills, linked mathematics problems with previous knowledge and local teaching materials, culture, and daily life.

The first code illustrated that out of three participants perceived that CBA is different from traditional teaching methods in mathematics. Participant T2 mentioned, *"In traditional teaching, even the classes that the mathematics teachers think they are teaching well, the students seem quiet, develop the habit of just calculating and*

memorizing". T4 said *"In the contextual teaching strategy, students learn mathematics through learning by doing, cooperation, and motivation. Similarly, there are two-way communications between teachers with students in mathematics classroom practice'.* The second code noticed that out of three participants, CBA is a teaching strategy in which mathematics teachers contextualize mathematics with local activities and life-based skills. They connected mathematics problems with previous knowledge of students, teaching materials, and cultural practices. For instance, T3 states, *"In my experience, I used to instruct students based on their prior knowledge connected with subject matter. For example, when teaching geometry, students are connected to the subject matter based on their daily activities and experiences, such as home pipes, rolls, roti, tents, doko,* etc.

Similarly, participant T4 said, '*When teaching mathematics subjects related to context, I use locally made teaching materials and ICT to give ideas and concepts to students based on the content".* The Context-Based Approach effectively connects mathematical content with students' contexts, utilizing locally available teaching materials, daily life activities, ICT, and cultural practices in mathematics teaching. Thus, mathematical content can connect 'context with students' real-life experiences in teaching teaching-learning process.

Perceived Benefit and Readiness to Use CBA in their Classroom

This category includes codes such as experiences of using CBA in home arithmetic, local materials, ICT, and contents offering active participation concepts and perceived benefit. The first and second codes indicate that, for three participants, CBA is an effective teaching approach. Home arithmetic content is learned using local materials and ICT, facilitating active participation and engagement. In this regard, participant T2 mentioned *"In the context of the use of contextual teaching strategy in mathematics teaching, when teaching home arithmetic, I have been teaching by connecting examples like coloring, telephone bill, and electric bill, etc*. The third and second codes reported that out of two participants, CBA is widely considered beneficial to both teachers and students in mathematics education. This approach offers active participation and engagement in mathematics learning such as the quote of a participant T5 as *" This teaching approach is considered effective as the active participation of students in mathematical learning can be interested and motivated*". The result suggested that teachers perceived the benefit of using CBA in mathematics classroom teaching.

Perceived Difficulties of Implementing CBA

The overall findings of the study revealed that the participants perceived multi-level difficulties regarding CBA. This theme includes three sub-themes such as individual difficulties, institutional difficulties, and system-based difficulties while implementing CBA in mathematics.

Individual Difficulties

This category includes codes like difficulty in preparing materials, lack of knowledge regarding CBA, low opportunity to use CBA, and willingness to apply CBA strategies.

The first code indicated that out of two participants, the teacher considered challenges while preparing materials based on CBA in mathematics classroom practice. For example, the quote of participant T2 uttered "*In my classroom practice, due to the large number of students, there is a problem in teaching through connection with the context and students' experiences, using and developing teaching materials in mathematics".* The second code illustrated that the entire participants agreed they did not have sufficient awareness regarding the CBA in using mathematics in the classroom. In this relation, the quote of Participant T3 is: *In my experience, we have no sufficient knowledge and ideas on using CBA in the classroom.* The third and fourth codes reported that unanimously all participants were motivated to use CBA in their classrooms but had limited opportunity to apply them. For instance: participant T5 states*' traditional way of evaluation system has not given the opportunity to effectively implement the CBA in mathematics"*. Participants have expressed concerns about their readiness to implement the Context-Based Approach in mathematics education, mentioning a lack of awareness and sufficient knowledge about this approach. It indicates that mathematics teachers have not yet practiced the Context-Based Approach (CBA) by its model. This gap in practice may stem from several factors, including a lack of awareness, insufficient training, and inadequate resources.

Institutional Difficulties

This category includes the codes as lack of human resources, a large number of students, low classroom management, no ICT-friendly classroom, and insufficient infrastructure.

The first code indicated that all participants identified a lack of human resources as the major challenge to effectively using CBA in mathematics. Participant T2 stated, 'There are not enough human resources and teaching equipment in our school. The second and third codes reflected that all participants stated they do not follow procedures of CBA in their classroom due to the large number of students and low classroom management. In this regard, participant T1 expressed *"In my classroom practice, due to the large number of students, there is a problem in teaching through connection with the context and students' experiences, using and development teaching materials in mathematics*". The fourth and fifth codes noted that two participants recognized the main challenges for implementing CBA as a lack of ICT-friendly classrooms and insufficient infrastructure. Participant T2 stated *"There is not sufficient human resources and teaching equipment in our school. There is no ICT-friendly classroom and traditional classroom management has not supported in using CBA"*. In this context another participant T4 said, *"We do not*

have sufficient infrastructure development in classroom teaching". This implies that traditional classroom settings, insufficient teaching materials and equipment, and a lack of qualified human resources pose significant challenges to the implementation of the Context-Based Approach in mathematics education.

System based difficulties

This category includes the codes as lack of teaching materials, time management difficulties, and magnitude of traditional teaching culture.

The first code illustrated that one participant stated that our education system has not promoted the construction and use of teaching materials in classroom practices. Related to this subject, T1 argued,*" Our mathematics curriculum and textbook have not emphasized context-based teaching contents, materials and pedagogy".*

This category includes the codes as lack of teaching materials, time management difficulties, and magnitude of traditional teaching culture.

The first code illustrated that one participant stated that our education system has not promoted the construction and use of teaching materials in classroom practices. Related to this subject T1 argued,*" Our mathematics curriculum and textbook have not emphasized context-based teaching contents, materials and pedagogy".* The second code implied the experiences of one of the participants as one shared his/her teaching experiences mentioning that there is not sufficient time to conduct and use CBA in the classroom. Another participant T3 stated, *"In my observations, classroom management and time management are the main problems to implement contextual teaching strategy effectively".* The third code noticed that all participants stated the magnitude of traditional teaching culture highly influences the implementation of CBA in mathematics. In this context, participant T5 stated,*" traditional way of evaluation system has not given opportunity to effectively implement the contextual teaching strategy in mathematics".* This means the current educational frameworks, policies, and leadership do not prioritize the implementation of the Context-Based Approach in mathematics education.

Discussion

The study aimed to explore secondary-level teachers' perceptions of using the context-based approach (CBA) in mathematics teaching. The CBA integrates real-world contexts and situations into the teaching of mathematical concepts, making learning more relevant and engaging for students. The discussion section involves interpreting the findings and connecting them with relevant literature for triangulation.

In the first theme a *perceived understanding of CBA,* it is found that teachers view conceptual understanding of CBA as the combination of planning, application, and

evaluation in mathematics teaching. The findings reveal that CBA in mathematics is teaching and learning concepts within the context of real-life situations and applications, making the material more relevant and engaging for students. In my reflection, CBA is a new approach based on students' prior knowledge and their own experiences in this context. Miyambo (2020) expressed that CBA is a teaching method that involves using learners' real-life experiences in mathematics teaching. The constructivist theory focuses on learning as an active process in which learners can connect prerequisite knowledge with newly acquired knowledge (Gunter, 2018). Also, Glynn and Koballa (2005) mentioned that CBA practices are more interesting and helpful than the traditional approach in which students have an opportunity to learn mathematical concepts through hands-on methods. This indicates that CBA is a teaching strategy based on real-life experiences in various contexts in mathematics.

The results show that content and context are connected through the Context-Based Approach (CBA). Johnson (2002) argued that CBA establishes a relationship between content and its context. It engages students in meaningful activities that help them connect academic studies to real-life situations. A similar understanding of CBA is supported by Jubhari et al. (2022) and Sholikhah et al. (2023), who emphasize that this approach fosters deeper learning and enhances students' ability to apply their knowledge in practical contexts. However, linking context with content in mathematics teaching is not an essay task (Widjaja, 2013). Thus secondary level teachers perceived that a context-based approach is beneficial and adequate in mathematics teaching.

In the theme of *Perceived Difficulties of Implementing CBA,* it is seen that teacher's opinion is taken under three categories: Individual difficulties, intuitional difficulties, and system-based difficulties. In terms of individual difficulties, teachers lack knowledge about CBA, and it is difficult to prepare materials. They have low opportunity to use CBA and they do not have sufficient awareness regarding the CBA in using mathematics in the classroom. Similar results are to be found in mathematics education (Romberg, 2013), science education (King, 2007), and the Nursing field (Wilson et al., 2018). So, it is needed more education about CBA for students, teachers, and parents. In this regard, Taher et al. (2019) argue that teachers have no creativity and awareness to implement CBA in classroom practice. Therefore, teachers do not practice as they lack sufficient knowledge to conduct CBA in mathematics teaching. In terms of intuitional difficulties, teachers see the major challenge to effectively using CBA in mathematics as a large number of students and a lack of human resources. Similarly, while conducting CBA, there is an absence of ICT-friendly classrooms and insufficient infrastructure. Similar issues were mentioned by Panthi and Belbase (2017) in teaching mathematics in the context of Nepal. Lastly, regarding system-based difficulties, education systems are influenced by the magnitude of traditional teaching culture, which complicates the

implementation of the Context-Based Approach (CBA) in mathematics instruction. Secondary-level science teachers have reported similar challenges when using this approach across various subjects. They faced issues such as managing program content and time, selecting appropriate materials, determining suitable contexts, and handling classroom management during the teaching process (Gungor et al., 2023). Consequently, secondary-level teachers perceive multiple difficulties in implementing mathematics instruction.

Conclusion

This study explored secondary-level mathematics teachers' perceptions of using a Context-Based Approach (CBA) in mathematics teaching. Teachers generally perceive CBA as a beneficial method for enhancing student engagement and understanding by linking mathematical concepts to real-life situations and experiences. Based on the study's findings, it was concluded that secondary-level mathematics teachers had a positive understanding of the Context-Based Approach (CBA) in mathematics education. They believe that CBA enhances the teaching and learning process by integrating real-life contexts and applications, making the material more relevant and engaging for students by linking mathematical concepts to their experiences and prior knowledge. Despite these positive perceptions, teachers also identified several challenges in implementing CBA effectively. These challenges include a lack of resources, time constraints, and difficulties in aligning CBA with existing curriculum requirements. Furthermore, a gap was observed between teachers' theoretical understanding of CBA and their ability to apply it in classroom settings. This suggests a need for more targeted professional development and support to help teachers integrate CBA into their teaching practices more effectively.

The study is limited by its small sample size, focusing only on teachers from community-based schools, which may affect the generalizability of the findings to other educational contexts. Additionally, the study reveals a disparity between teachers' positive perceptions of CBA and their actual classroom practices. Future research should aim to bridge this pedagogical gap, explore the factors influencing CBA usage, and involve both teachers and students in larger-scale studies using mixed methods and intervention-based approaches.

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