Use of Scaffolding Strategies in Teaching and Learning of Mathematics in Class IX: Teachers’ and Students’ Perceptions

**Abstract**

Scaffolding is an instructional strategy that provides individualized support within a learner’s Zone of Proximal Development (ZPD). Rooted in socio-constructivist theory, it enhances teaching and learning by guiding students toward deeper understanding and skill development.

This study examines teachers' and students' perceptions of scaffolding, its impact, and the challenges of implementing scaffolding strategies in Class Nine mathematics instruction. Using a convergent parallel mixed-method design, data were collected from 333 students and 14 mathematics teachers across four Higher Secondary Schools in Samtse Dzongkhag. The survey questionnaire and interview were used to collect the data. Quantitative data were analyzed using SPSS version 22, while qualitative data were analyzed thematically.

Findings reveal that both teachers and students perceive scaffolding strategies as highly beneficial, improving student engagement, comprehension, and learning outcomes. However, challenges such as large class sizes, limited instructional time, an extensive syllabus, and resource constraints hinder effective implementation.

The study concludes that scaffolding is a valuable strategy to enhancing mathematics instruction. It recommends the integration of diverse scaffolding strategies in Bhutanese classrooms to improve teaching effectiveness and student performance.

Keywords: scaffolding, zone of proximal development, constructivist theory,

**CHAPTER 1: INTRODUCTION**

**1.1 Background of the Study**

Traditional mathematics instruction has been predominantly teacher-centered, where teachers control the flow of knowledge, and students passively receive information (O’Neill & McMahon, 2005). While widely used, this approach has been criticized for limiting student engagement and failing to develop deeper understanding and problem-solving skills (Kapur, 2016).

In contrast, constructivist learning theories emphasize that knowledge is actively constructed rather than passively received (Vintere, 2018). This approach recognizes that students learn best when they engage with new information, build on prior knowledge, and construct meaning through experiences (Boaler, 2019). Vygotsky’s (1978) social constructivist theory highlights the importance of social interaction in learning, introducing key concepts such as the Zone of Proximal Development (ZPD) and scaffolding (Slavin, 1997). Scaffolding provides structured support to help students transition from assisted to independent learning (Shabani et al., 2010).

Research indicates that scaffolding enhances students’ ability to engage in higher-order thinking and problem-solving (Siyepu, 2013). By identifying students’ learning needs within their ZPD, teachers can provide targeted support to reinforce mathematical reasoning and conceptual understanding (Puntambekar & Hubscher, 2005). Globally, studies have demonstrated that scaffolding fosters deeper mathematical learning, improves problem-solving abilities, and boosts student confidence (Boonen et al., 2021).

Despite curriculum reforms promoting student-centered learning, Bhutanese mathematics classrooms still rely on traditional, teacher-directed instruction (Dolma et al., 2017). Many teachers struggle to implement active learning strategies, leading to an emphasis on rote memorization (Kaur, 2022). This challenge, rooted in Bhutan’s monastic education traditions, has contributed to students’ disengagement and consistently low performance in mathematics (Tenzin & Dorji, 2021).

Given these challenges, this study explores Bhutanese mathematics teachers' and students’ perceptions of scaffolding, its impact on learning, and barriers to its implementation. The findings aim to provide insights into integrating scaffolding strategies effectively to enhance student engagement and achievement in Bhutanese mathematics classrooms.

* 1. **Problem Statement**

Mathematics achievement in Bhutan remains consistently low compared to other subjects. National and international assessments highlight students' ongoing struggles with mathematical concepts. In the 2017 PISA-D test, Bhutan’s mathematics literacy rate was only 38.8% (NPC, 2017). Similarly, reports from the Bhutan Council for School Examinations and Assessment (BCSEA, 2016–2019) show that Class X mathematics results have persistently fallen below expectations. In 2021, only 46.85% of students passed mathematics, making it the lowest-performing subject.

Despite being a core and compulsory subject (Drukpa, 2015), mathematics remains a major academic challenge for Bhutanese students. His Majesty the 5th King, during the 2019 convocation of Samtse and Paro Colleges of Education, noted that while mathematics is a favorite subject in India, it is a significant weakness in Bhutan, with most students scoring below 50%. Studies such as the National Education Assessment (NEA, 2003) and the Annual Status of Students Learning (ASSL, 2008, 2010, 2011) further indicate that Bhutanese students' mathematics proficiency lags behind international standards.

Although the Bhutanese mathematics curriculum promotes a constructivist, student-centered approach, student performance remains low. This gap between curriculum intent and student outcomes suggests a lack of effective instructional strategies that foster active learning and comprehension.

Scaffolding, a teaching strategy rooted in constructivist theory, provides guided support to help students develop mathematical understanding and problem-solving skills (Machmud, 2011). However, the extent to which scaffolding is effectively implemented in Bhutanese classrooms remains unclear.

This study aims to explore teachers' and students' perceptions of scaffolding in mathematics instruction, assess its impact on student learning, and identify challenges in its implementation. Additionally, research on scaffolding in Bhutanese classrooms is limited. By addressing this gap, the study seeks to provide insights into the effectiveness of scaffolding strategies in improving mathematics education in Bhutan.

**1.3 Aim of the Study**

Research aims define the overarching goal or purpose of a study (Thomas & Hodges, 2010). Research objectives further specify the key topics or issues to be explored, building upon the main research aim. The primary aim of this study is to investigate the perceptions of mathematics teachers and students regarding the use of scaffolding strategies and their impact on teaching and learning mathematics in Class IX.

**1.4 Research Objectives**

The objectives of this study are:

* To examine mathematics teachers’ and students’ perceptions of the use of scaffolding in teaching and learning mathematics.
* To analyze the perceived impacts of scaffolding on students’ learning outcomes in mathematics classrooms.
* To identify the challenges faced in implementing scaffolding strategies in mathematics education.
* To explore various scaffolding strategies used in the teaching and learning of mathematics.

**1.5 Research Questions**

This study aims to address the following research question:

What are the perceptions of Mathematics teachers and students on the use of scaffolding in teaching and learning mathematics in Class IX?

**Sub-questions**

* How do mathematics teachers and students perceive the level of scaffolding in mathematics classes?
* What are the perceived impacts of scaffolding on students’ learning and engagement in mathematics classes?
* What scaffolding strategies are currently being used in teaching and learning mathematics?
* What are the challenges faced by teachers and students in implementing scaffolding techniques in mathematics education?

**1.7 Significance of the Study**

This study is significant as it provides **practical insights into the role of scaffolding strategies in enhancing mathematics education**. By identifying effective scaffolding methods, it equips **mathematics teachers with structured approaches** to improve student engagement, participation, and learning outcomes. The study also supports **curriculum implementers and policymakers** in recognizing the importance of scaffolding in addressing students' learning needs and aligning instruction with their **Zone of Proximal Development (ZPD)**. Furthermore, it serves as a **valuable resource for curriculum developers**, helping them integrate scaffolding techniques into lesson plans and teaching materials to foster a more interactive and student-centered learning environment. Ultimately, this research strengthens efforts to **improve mathematics achievement** by ensuring that instructional strategies are responsive to students' learning progress and challenges.

**CHAPTER 2: LITERATURE REVIEW**

**2.1 Definition of Scaffolding**

Scaffolding is a widely accepted instructional strategy that supports student learning by providing structured guidance, gradually withdrawn as learners gain independence (Yelland & Masters, 2007). Rooted in Vygotsky’s (1978) Zone of Proximal Development (ZPD), scaffolding helps students acquire new knowledge, skills, and problem-solving abilities through expert support.

Scaffolding, based on socio-cultural and constructivist theories, refers to structured support provided by a more knowledgeable individual, such as a teacher or peer, to help learners progress from assisted to independent problem-solving (Vygotsky, 1978; Wood, Bruner, & Ross, 1976). This temporary guidance, which includes modeling, questioning, and feedback, enhances learning within the ZPD (Vvan de Pol, Volman, & Beishuizen, 2010).

Recognized as an effective instructional strategy, scaffolding ensures meaningful learning experiences by adapting support to students’ needs (Gonulal & Loewen, 2018). In mathematics education, it fosters engagement, comprehension, and deeper conceptual understanding.

The concept of scaffolding has evolved over the years, with researchers offering various definitions. Wood, Bruner, and Ross (1976) described scaffolding as a process that enables learners to solve problems, perform tasks, or achieve goals that would be unattainable without guidance. Raymond (2000) defined scaffolding as an instructional strategy that incrementally enhances learners' ability to build on prior knowledge. Similarly, Benson (1997) viewed scaffolding as an enabler, rather than a disabler, in the learning process, while Slavin (1997) emphasized its role in providing structured assistance. Later, Gonulal and Loewen (2018) highlighted that scaffolding is broadly applied in education, encompassing various strategies that support student learning.

**2.2 Scaffolding in Mathematics Education**

Scaffolding is essential in mathematics education, helping students navigate complex problem-solving through teacher guidance, peer collaboration, and educational tools such as manipulatives and digital technologies (Rosenshine & Meister, 1992; Puntambekar & Hübscher, 2005). Finali, Rulyansah and Hutama (2023) stated that teacher’s scaffolding strategies impact on arithmetic abilities, enthusiasm in mathematics and desire to explore. Furthermore, Van de Pol and Elbers (2024) strongly supported that teacher’s use of scaffolding strategies effectively supports small groups during mathematical discussion, enhancing collaborative learning.

Intentionally using scaffolding strategies improve the learning environment to promote widening participation (Gummerson & Hummarlund, 2024). It enhances engagement, reduces cognitive overload, and boosts confidence in problem-solving. Additionally, technology-enhanced scaffolding, such as intelligent tutoring systems and digital simulations, has shown promising results in supporting mathematics learning (Azevedo & Gašević, 2019).

**2.3 Forms and Applications of Scaffolding**

Scaffolding occurs through teacher-student, peer, and student-material interactions (Puntambekar & Hübscher, 2005). Teachers scaffold learning by modeling problem-solving, guiding practice, and providing feedback (Walqui, 2006). Peer-assisted learning and collaborative problem-solving further enhance mathematical understanding (Kirschner, Sweller, & Clark, 2017).

Educational tools, including graphic organizers, interactive software, and visual aids, help bridge the gap between abstract mathematical concepts and student comprehension (Belland et al., 2017). Research highlights scaffolding’s effectiveness in fostering independent learning, conceptual understanding, and confidence in mathematics (Azevedo & Gašević, 2019; van de Pol et al., 2015).

Scaffolding extends beyond direct teacher support to include peer collaboration, technological tools, and instructional artifacts. Digital platforms, adaptive learning systems, and textual supports dynamically adjust to learners' needs, fostering engagement with complex content (Azevedo & Hadwin, 2005; Belland et al., 2015).

Vygotsky (1978) emphasized that instruction should target a learner’s Level of Potential Development (LPD) rather than their Actual Development Level (ADL), as teaching known concepts does not promote cognitive growth (Chalaye & Male, 2011). Effective scaffolding introduces challenges slightly beyond a learner’s current ability, stimulating deeper learning (Cole & Cole, 2001).

Holton and Clarke (2006) highlighted self-scaffolding as a metacognitive process fostered through guided reflection. Similarly, Van de Pol et al. (2010) categorized scaffolding into cognitive, metacognitive, and affective domains, stressing its role in shaping students’ attitudes, motivation, and beliefs.

**2.4 Perceptions of Scaffolding’s Impact**

Scaffolding bridges the gap between a learner’s current knowledge and potential development. Vygotsky’s (1978) Zone of Proximal Development (ZPD) defines this space, where structured support enables students to work beyond their independent capability (Frederick et al., 2014).

**2.5 The Role of ZPD in Scaffolding**

The ZPD is assessed by determining a learner’s current abilities and their potential with guidance (Vygotsky, 1978). Instruction within the ZPD facilitates problem-solving beyond independent capacity (Puntambekar & Hübscher, 2005). Larkin (2002) emphasized scaffolding as a key instructional principle that allows teachers to cater to individual student needs.

When concepts are introduced within a student’s ZPD, it enhances motivation and cognitive development (Jaramillo, 1996). Scaffolding encourages learners to extend their knowledge, initially collaborating with a teacher or peer before internalizing skills for independent problem-solving (Shabani et al., 2010).

**2.6 Effectiveness of Scaffolding in Education**

Extensive research affirms scaffolding as a vital instructional strategy (Stuyf, 2002). Structured activities, guided discussions, and interactive exercises enhance student comprehension and engagement (Siyepu, 2013). Scaffolding also strengthens metacognitive awareness, promoting independent learning and deeper conceptual understanding (Holton & Clarke, 2006; Van de Pol et al., 2010).

Grounded in Vygotsky’s ZPD framework, scaffolding bridges the gap between students' current abilities and their potential development. By integrating teacher guidance, peer collaboration, and technology, scaffolding facilitates problem-solving, enhances understanding, and fosters independent learning. As research evolves, it remains central to effective instructional design, ensuring students receive both challenge and support in their learning journey.

**2.7 Implementing Scaffolding Strategies in Learning**

Scaffolding supports student learning through structured instructional strategies that enhance engagement, deepen understanding, and foster independence (Van de Pol et al., 2010). Key scaffolding techniques include:

1. *Feedback and Questioning*

Timely feedback helps students monitor progress and refine their understanding (Hattie & Timperley, 2007). Continuous, targeted feedback guides learning more effectively than post-task evaluation. Similarly, structured questioning promotes critical thinking and active engagement, encouraging students to reflect and explore different perspectives (Rosenshine, 2012).

1. *Interactive Learning*

Collaborative discussions, group work, and peer interactions enhance comprehension and reasoning skills (Webb, 2013). Interactive classrooms foster deeper engagement by encouraging knowledge exchange and cooperative problem-solving.

1. *Activating Prior Knowledge*

Building on students’ existing knowledge helps contextualize new content, making learning more meaningful (Bransford et al., 2004). Encouraging connections between prior experiences and new concepts enhances retention and comprehension.

1. *Task Breakdown and Multiple Approaches*

Dividing complex concepts into smaller tasks improves understanding and reduces cognitive overload (Kirschner, Sweller, & Clark, 2006). Using varied instructional methods, such as step-by-step explanations, hands-on activities, and multimedia resources, reinforces learning from different perspectives.

1. *Modeling and Demonstration*

In modeling and demonstration, teachers guide students through problem-solving techniques before gradually transferring responsibility (Alber, 2014). Repeated demonstrations ensure students grasp both procedural steps and underlying concepts. In similar note, Liang and Tsai (2021) strongly supported that utilizing single and multiple representational scaffolding enhances mathematical problem-solving skills.

1. *Visual Aids and Technology*

Scaffolding extends beyond teacher-student interactions to include visual and digital tools that support learning (Belland et al., 2015). Technology-enhanced scaffolding, such as interactive simulations and self-paced digital tools, enables adaptive and independent learning.

Scaffolding provides structured yet flexible support that gradually fosters independent, critical, and adaptive learners. By integrating effective strategies, teachers can enhance engagement and improve learning outcomes in evolving educational environments.

**2.8 Challenges of Implementing Scaffolding**

Despite its effectiveness, scaffolding poses several challenges. Pressley et al. (1996) emphasized its complexity, requiring careful planning and adaptability. Key challenges include:

* Targeted Support: Over-scaffolding can hinder independence, while under-scaffolding may leave students struggling (van de Pol et al., 2010).
* Curriculum Awareness: Teachers must understand content difficulty to allocate appropriate scaffolding (Rosenshine & Meister, 1992).
* Flexible Prompting: Effective scaffolding requires multiple instructional cues and adaptability when initial explanations fail (Saye & Brush, 2002).
* Diverse Learning Needs: Differentiation is crucial but challenging, as students have varied learning styles and abilities (Sharma & Hannafin, 2007).
* Time Constraints: Individualized scaffolding is time-intensive, making it difficult to balance with curriculum demands (Rachel & Van Der, 2002).

In large classrooms, managing scaffolding for students with different Zones of Proximal Development (ZPD) is particularly difficult (Stone, 1996; Al-Yamin, 2008). Misjudging a student’s ZPD may lead to ineffective support—tasks that are too easy fail to challenge, while overly difficult tasks cause frustration (Shabani et al., 2010).

Successful scaffolding requires strategic planning, assessment, and adaptability. Addressing time constraints and diverse student needs remains a challenge, but advancements in technology-enhanced and peer-assisted scaffolding offer promising solutions for more practical implementation in varied classroom settings.

**2.9 Research Gap**

Despite extensive research highlighting the benefits of scaffolding in mathematics education globally, there is limited empirical evidence on its implementation and effectiveness in Bhutanese classrooms. Existing studies emphasize the role of scaffolding in improving student engagement, problem-solving skills, and conceptual understanding, yet the extent to which Bhutanese teachers utilize scaffolding strategies remains unclear. Additionally, while curriculum reforms in Bhutan advocate for student-centered learning, traditional teacher-directed instruction continues to dominate, potentially limiting the impact of scaffolding techniques.

Furthermore, there is also a lack of insight into teachers’ and students’ perceptions of scaffolding and the challenges associated with its implementation. Given the persistent low performance in mathematics among Bhutanese students, understanding the role of scaffolding in enhancing learning outcomes is crucial.

This study aims to bridge these gaps by examining the perceptions of teachers and students regarding scaffolding strategies in Class IX mathematics instruction. It will also explore the specific scaffolding strategies used, their perceived impact on student learning, and the challenges teachers face in implementing them. The findings will contribute to the development of effective instructional approaches aligned with Bhutan’s educational goals, ultimately enhancing student engagement and achievement in mathematics.

**CHAPTER 3: METHODOLOGY**

**3.1 Research paradigm**

This study adopts the pragmatist paradigm, which prioritizes research outcomes and questions over rigid methodologies (Kaushik & Walsh, 2019). Pragmatism focuses on solving real-world problems (Biesta, 2010) and supports mixed-method research (Creswell & Clark, 2011). Thus, this study integrates quantitative and qualitative methods to examine the impact of scaffolding on mathematics teaching and learning.

**3.2 Research Approach**

A mixed-method approach was chosen to enhance the validity and reliability of findings. It combines quantitative data to measure scaffolding prevalence with qualitative insights into teachers’ and students’ experiences (Johnson et al., 2007). This approach is widely used in education research for its ability to address complex issues (Plano Clark, 2017).

**3.3 Research Design**

The study employs a convergent parallel mixed-method design, which allows simultaneous collection and integration of qualitative and quantitative data (Creswell, 2012). This design ensures that statistical findings are complemented by in-depth perspectives, leading to richer insights (Tashakkori & Teddlie, 2010).

**3.4 Population and Sampling**

The study targeted the population of Class IX students and mathematics teachers from four high schools in Samtse Dzongkhag. For quantitative data collection, **purposive sampling** was used, involving **333 students and 14 teachers**. Additionally, **11 students and 7 teachers** were randomly selected for in-depth interviews to gain deeper insights into their perceptions of scaffolding strategies in mathematics teaching and learning.

**3.5 Research Instruments**

Collecting data means identifying and selecting individuals for a study, obtaining their permission to study them, and gathering information by asking people questions or observing  
their behaviors (Creswell, 2012). A mixed method research design is composed of both quantitative and qualitative method and it uses various procedures of collecting data. The main  
instruments used in the mixed method researches consist of survey questionnaires, interviews and classroom observations (Zohrabi, 2013). He further stated that these different ways of gathering information can supplement each other and hence boost the validity and dependability of the data.

To measure the perception of Mathematics teachers and students on use of scaffolding in teaching and learning mathematics, a researcher used survey questionnaire and interview as the main research instruments to collect data. The data collection tools were developed by the author to align the findings with the aims and objectives of the research.

**3.6 Validity and Reliability**

The reliability of the questionnaires was tested using Cronbach’s Alpha, yielding values of 0.89 (teachers) and 0.79 (students), indicating high internal consistency (Hof, 2012). Interview validity was established through expert review and member checking.

**3.7 Data Analysis**

Quantitative data were analyzed using SPSS (IBM v22), applying descriptive statistics (frequencies, percentages, means, and standard deviations). A five-point scale adapted from Timur and Taşar (2011) categorized perception levels. Triangulation was employed to compare quantitative and qualitative findings, strengthening validity.

**Table 1**

*Criteria for level of perception on scaffolding*

|  |  |  |
| --- | --- | --- |
| **Mean Scores** | **Level of Perception** | **Level of Rating** |
| 1. – 1.79 | Very Low | Strongly Disagree |
| 1.80 – 2.59 | Low | Disagree |
| 2.60 – 3.39 | Medium | Neutral |
| 3.40 – 4.19 | High | Agree |
| 4.20 – 5.00 | Very High | Strongly Agree |

Adapted from Timur & Taşar (2011)

This structured methodology ensures a comprehensive and credible investigation into scaffolding strategies in mathematics education.

**CHAPTER 4. RESULT**

**4.1 Demographic Information**

The demographic profile of participants forms the basis for interpreting the study findings. Table 2 summarizes participant details. The survey included 162 male (48.6%) and 171 female (51.4%) students. Among teachers, there was an equal distribution of males (50%) and females (50%). For interviews, 11 students (5 males, 6 females) and 7 teachers (3 males, 4 females) were randomly selected.

Table 2

*Demographic information of the participants*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  |  | **Gender** | **N** | **Percent** |
| **Survey Questionnaire Participants** | Students | Male | 162 | 48.6 |
| Female | 171 | 51.4 |
| Total | 333 | 100 |
|  |  |  |  |
| Mathematics Teachers | Male | 7 | 50 |
| Female | 7 | 50 |
| Total | 14 | 100 |
| **Interview Participants** | Students | Male | 5 | 45.5 |
|  | Female | 6 | 54.5 |
|  | Total | 11 | 100 |
|  |  |  |  |
| Mathematics Teachers | Male | 3 | 42.9 |
|  | Female | 4 | 57.1 |
|  | Total | 7 | 100 |

**4.2 Teachers’ Perceptions of Scaffolding in Teaching and Learning Mathematics**

This section explores mathematics teachers’ perceptions of scaffolding strategies in their teaching. Teachers rated the effectiveness of these strategies, analyzed using Mean (M), Standard Deviation (SD), and Percentage (%), as summarized in Table 3. Specific items under each scaffolding strategy are detailed in Table 4.

The analysis of these perceptions was conducted using Mean (M), Standard Deviation (SD), and Percentage (%), as summarized in Table 3. Additionally, specific items under each scaffolding strategy were analyzed separately in Table 4.

**Table 3**

*Teachers’ perception level on different scaffolding strategies*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | **Min** | **Max** | **Mean** | **SD** | **Level of Perception** |
| Activate Prior knowledge | 14 | 3.20 | 4.80 | 4.16 | .521 | High |
| Visual Scaffolding | 14 | 3.67 | 5.00 | 4.42 | .380 | Very High |
| Interactive scaffolding | 14 | 3.25 | 5.00 | 4.16 | .534 | High |
| Multiple ways | 14 | 3.33 | 5.00 | 4.14 | .484 | High |
| Math Talk and Questionings | 14 | 3.50 | 5.00 | 4.29 | .448 | Very High |
| Model and demonstration | 14 | 3.00 | 5.00 | 4.20 | .502 | Very High |
| **Average** | **14** | **3.45** | **4.95** | **4.22** | **.413** | **Very High** |

*(Note: 1.0 – 1.79 = Very Low/Strongly Disagree, 1.80 – 2.59 = Low/Disagree, 2.60 – 3.39 = Medium/Neutral, 3.40 – 4.19 = High/Agree, 4.20 – 5.00 = Very High/Strongly Agree)*

**Table 4**

*Teachers’ perception on each item of different scaffolding strategies*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scaffolding**  **Strategies** | **Items** | **N1** | **SD**  **%** | **D**  **%** | **N2**  **%** | **A**  **%** | **SA**  **%** | **M** | **SD** |
| Activate Prior knowledge | I always check students’ prior knowledge prior to teaching the lesson topic | 14 | 0 | 0 | 0 | 35.7 | 64.3 | 4.64 | .497 |
| I assess students’ ability level before I offer any scaffolding instruction | 14 | 0 | 0 | 21.4 | 50.0 | 28.6 | 4.07 | .730 |
| I take into account students’ previous knowledge to plan the activities based on their level | 14 | 0 | 0 | 14.3 | 64.3 | 21.4 | 4.07 | .616 |
| I always make judgements about the need and the quality of the assistant that is required by the learners | 14 | 0 | 14.3 | 14.3 | 50.0 | 21.4 | 3.79 | .975 |
| Visual Scaffolding | I use varieties of teaching aids like play cards, models, animations, audio-visuals, manipulatives, etc., in teaching mathematics | 14 | 0 | 0 | 14.3 | 57.1 | 28.6 | 4.14 | .663 |
| I use visual aids to enables communication and to helps students see the creativity in doing mathematics | 14 | 0 | 0 | 0 | 50 | 50 | 4.50 | .519 |
| I use effective visual aids to convey concepts and lessons with more clarity and effectiveness | 14 | 0 | 0 | 0 | 35.7 | 64.3 | 4.64 | .497 |
| Interactive scaffolding | I used different small interactive groups while carrying out class activities | 14 | 0 | 0 | 21.4 | 42.9 | 35.7 | 4.14 | .770 |
| I facilitate and monitor appropriate interaction among students | 14 | 0 | 0 | 14.3 | 64.3 | 21.4 | 4.07 | .616 |
| I encourage learning through group interaction, active learning, participation and collaboration among students | 14 | 0 | 0 | 0 | 57.1 | 42.9 | 4.43 | .514 |
| I use discussion as one of the main components of teaching strategy | 14 | 0 | 0 | 21.4 | 57.1 | 21.4 | 4.00 | .679 |
| Multiple ways | I always use multiple ways to teach mathematics concepts | 14 | 0 | 0 | 14.3 | 57.1 | 28.6 | 4.14 | .663 |
| I always incorporate multiple strategies to solve mathematics problem | 14 | 0 | 0 | 7.1 | 64.3 | 28.6 | 4.21 | .579 |
| I use effective strategies and techniques that actively engage students in the learning process | 14 | 0 | 0 | 7.1 | 78.6 | 14.3 | 4.07 | .475 |
| Model and demonstration | I model the tasks to demonstrate what students are expected to do (e.g., presentation, demonstration, etc.,) | 14 | 0 | 0 | 21.4 | 64.3 | 14.3 | 3.93 | .611 |
| I relate the mathematical problem with real events, phenomena, processes and real-world applications | 14 | 0 | 0 | 7.1 | 57.1 | 35.7 | 4.29 | .611 |
| I use demonstration to support explanations and scaffold students’ understanding | 14 | 0 | 0 | 14.3 | 35.7 | 50 | 4.36 | .745 |
| Math talks and Questionings | I use different questioning techniques as one of the strategies in teaching mathematics | 14 | 0 | 0 | 7.1 | 57.1 | 35.7 | 4.29 | .611 |
| I provide timely, constructive feedback to students about activities, assignments and questions(doubt) both verbally and written | 14 | 0 | 0 | 14.3 | 50 | 35.7 | 4.21 | .699 |
| I immediately consult my students to correct problem and keep them on task | 14 | 0 | 0 | 21.4 | 57.1 | 21.4 | 4.00 | .679 |
| Questioning is one of the tools to check student’s understanding | 14 | 0 | 0 | 0 | 35.7 | 64.3 | 4.64 | .497 |

*(Note: 1.0 – 1.79 = Very Low/Strongly Disagree, 1.80 – 2.59 = Low/Disagree, 2.60 – 3.39 = Medium/Neutral, 3.40 – 4.19 = High/Agree, 4.20 – 5.00 = Very High/Strongly Agree) (N1= Number of respondents; N2= Neutral)*

The results indicate that the overall perception of scaffolding strategies among mathematics teachers was very high (M=4.22, SD=0.413). Nearly 90% of teachers reported frequently using scaffolding strategies in their teaching. Among the six scaffolding strategies analyzed, Visual Scaffolding (M=4.42, SD=0.380), Math Talk and Questioning (M=4.29, SD=0.448), and Modeling and Demonstration (M=4.20, SD=0.502) received the highest ratings. The strategy with the lowest mean score was Multiple Ways (M=4.14, SD=0.484); however, it still fell within the high perception category.

*Key Findings from Itemized Analysis*

The highest-rated items included: "I always check students’ prior knowledge before teaching the lesson" (M=4.64, SD=0.497). "I use effective visual aids to enhance clarity and understanding" (M=4.64, SD=0.497). "Questioning is a key tool to check students’ understanding" (M=4.64, SD=0.497).

The lowest-rated item was: "I make judgments about the need and quality of assistance required by students" (M=3.79, SD=0.975), indicating that some teachers do not consistently assess students' needs before providing support.

The qualitative data from interviews aligned with the survey results, reinforcing that mathematics teachers highly value scaffolding strategies in their classrooms. Most teachers emphasized the importance of hands-on learning, guided facilitation, and student-centered approaches.

For instance, Teacher T3 shared: "Teachers are facilitators. They should not teach everything; instead, they should guide students and provide help when necessary. Mathematics is best learned through hands-on practice." Similarly, Teacher T7 highlighted the shift needed in Bhutanese classrooms: "In most Bhutanese mathematics classrooms, teachers dominate the lesson, leaving little space for students to explore and learn independently. It’s time to change that practice. Teachers should act as guides, scaffolding students’ learning when needed."

Common Scaffolding Strategies Identified: Providing hints and clues, Relating topics to prior knowledge, Using sample activities and examples, Incorporating teaching aids (visuals, models, animations, etc.), Encouraging peer interaction and feedback, Demonstrating and modeling problem-solving methods

Both quantitative and qualitative findings confirm that mathematics teachers have a high perception of scaffolding strategies and frequently incorporate them in their teaching. The data highlights the importance of scaffolding in making mathematical concepts more accessible and engaging for students.

**4.3 Students’ Perceptions of Scaffolding in Teaching and Learning Mathematics**

This section examines students’ perceptions of the scaffolding strategies employed in teaching and learning mathematics. The perception of each scaffolding strategy was analyzed using the Mean (M), Standard Deviation (SD), and Percentage (%).

Table 5

*Students’ perception level on different scaffolding strategies*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | **Min** | **Max** | **Mean** | **SD** | **Level of Perception** |
| Activate Prior knowledge | 333 | 1.00 | 5.00 | 3.83 | .685 | High |
| Visual Scaffolding | 333 | 1.00 | 5.00 | 3.83 | .761 | High |
| Interactive scaffolding | 333 | 1.43 | 5.00 | 3.76 | .685 | High |
| Multiple ways | 333 | 1.00 | 5.00 | 3.85 | .731 | High |
| Math Talk and Questionings | 333 | 1.00 | 5.00 | 3.80 | .803 | High |
| Model and demonstration | 333 | 1.25 | 5.00 | 3.97 | .777 | High |
| **Average** | **333** | **1.11** | **5.00** | **3.84** | **.596** | **High** |

*(Note: 1.0 – 1.79 = Very Low/Strongly Disagree, 1.80 – 2.59 = Low/Disagree, 2.60 – 3.39 = Medium/Neutral, 3.40 – 4.19 = High/Agree, 4.20 – 5.00 = Very High/Strongly Agree*

The descriptive statistics indicate that students have an overall high perception of the scaffolding strategies applied in mathematics instruction (M = 3.84, SD = 0.596). Among the six strategies, the use of multiple ways was rated the highest (M = 3.85, SD = 0.731). This finding contradicts the teachers’ perceptions, where this strategy was rated the lowest. On the other hand, interactive scaffolding received the lowest rating (M = 3.76, SD = 0.685), suggesting that students perceive fewer opportunities for interaction and discussion in the classroom. However, it still falls within the high perception level.

To further analyze student perceptions, survey questionnaire items under each scaffolding strategy were examined, as presented in Table 6. The item “My teacher uses multiple ways to solve mathematics problems” was rated the highest (M = 4.02, SD = 0.912), highlighting multiple approaches as a significant scaffolding strategy in mathematics instruction. Conversely, the item “My teacher gives plenty of opportunities to articulate concepts in my own words or understanding” was rated the lowest (M = 3.69, SD = 1.026), indicating that students feel they have limited opportunities to express their ideas and understanding.

Table 6

*Students’ perception on each item of different scaffolding strategies*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scaffolding**  **Strategies** | **Items** | **N1** | **SD**  **%** | **D**  **%** | **N2**  **%** | **A**  **%** | **SA**  **%** | **M** | **SD** |
| Activate Prior knowledge | My teacher always checks the prior knowledge prior to teaching any topic/lesson | 333 | 3.3 | 4.5 | 13.2 | 62.8 | 16.2 | 3.84 | .865 |
| My teacher always introduces the new lesson by connecting what I know already with what to learn | 333 | 3.9 | 6.9 | 13.5 | 48.6 | 27 | 3.88 | 1.01 |
| My teacher uses different pre-assessment techniques (like pretest, KWL, check the understanding, quizzes, etc.,) determine the prior knowledge on the topic | 333 | 2.1 | 8.1 | 21.6 | 48.3 | 19.8 | 3.76 | .933 |
| Visual Scaffolding | My teacher uses visual aids like drawing, pictures, posters, real objects while teaching the lesson | 333 | 4.8 | 7.5 | 15.9 | 45.0 | 26.7 | 3.81 | 1.06 |
| My teacher uses different visual aids to enhances learning mathematical concept | 333 | 3.0 | 8.4 | 15.9 | 49.2 | 23.4 | 3.82 | .985 |
| Real objects are being employed during the teaching it will make mathematical problem clearer and more understandable | 333 | 3.3 | 7.5 | 16.8 | 44.4 | 27.9 | 3.86 | 1.01 |
| Interactive scaffolding | My teacher uses different types of grouping | 333 | 3.6 | 10.2 | 18.3 | 46.2 | 21.6 | 3.72 | 1.03 |
| My teacher encourages group discussion | 333 | 3.6 | 9.6 | 19.5 | 37.8 | 29.4 | 3.80 | 1.08 |
| My teacher explains more to individual than to the whole class | 333 | 6.0 | 7.8 | 17.7 | 35.0 | 33.0 | 3.82 | 1.15 |
| I prefer group discussion over individual work | 333 | 3.0 | 6.6 | 25 | 42 | 22.8 | 3.75 | .978 |
| My teacher always helps me whenever I am in dilemma | 333 | 4.2 | 6.6 | 13.8 | 40 | 35 | 3.95 | 1.06 |
| Multiple ways | My teacher always breakdown the concept in small and simple chunks/pieces while delivering the ideas | 333 | 3 | 9.9 | 20.1 | 40.2 | 26.7 | 3.78 | 1.044 |
| My teacher uses multiple ways to solve mathematics problem | 333 | 1.8 | 6 | 11.9 | 49.5 | 30.9 | 4.02 | .912 |
| My teacher constantly gives me the feedback | 333 | 2.1 | 10.2 | 21.9 | 42.9 | 22.8 | 3.74 | .991 |
| Math Talk and Questionings | My teacher used to give hints/clues while solving mathematics problem | 333 | 5.7 | 5.7 | 13.2 | 45.9 | 29.4 | 3.88 | 1.075 |
| My teacher gives plenty of opportunity to articulate concepts in my own words or understanding | 333 | 4.2 | 8.4 | 22.5 | 44.1 | 20.7 | 3.69 | 1.026 |
| My teacher always listens to our ideas and supplement on our understanding | 333 | 3 | 6.6 | 20.4 | 42.3 | 27.6 | 3.85 | .998 |
| Model and demonstration | My teacher always shows an example of what we will be learning | 333 | 3.6 | 5.4 | 11.1 | 44.4 | 34.5 | 4.03 | 1.004 |
| My teacher always demonstrates the steps/procedure to solve math problem | 333 | 2.4 | 7.8 | 11.7 | 43.5 | 34.5 | 4.00 | .999 |
| My teacher uses simple and clear language while explaining | 33 | 3.6 | 4.2 | 13.2 | 38.4 | 40.5 | 4.08 | 1.013 |
| My teacher always relates mathematical concepts/ideas or problem with real-world events and application | 333 | 2.4 | 9.9 | 20.4 | 43.8 | 23.4 | 3.76 | .998 |

*(Note: 1.0 – 1.79 = Very Low/Strongly Disagree, 1.80 – 2.59 = Low/Disagree, 2.60 – 3.39 = Medium/Neutral, 3.40 – 4.19 = High/Agree, 4.20 – 5.00 = Very High/Strongly Agree) (N1= Number of respondents; N2= Neutral)*

*Qualitative Findings from Student Interviews*

The students’ interview responses reinforced the findings from the survey. All student participants acknowledged that their mathematics teachers employed various scaffolding strategies. For instance, one student (S1) remarked: “My teacher always checks my understanding of the topic before teaching and ensures that we grasp it well. They ask questions from previous lessons that relate to the new topic.”

Another participant (S2) emphasized the importance of questioning, stating: “Asking relevant questions is one of the best ways to help students understand the concepts being taught.”

The interview data further revealed that teachers use diverse scaffolding strategies, including video clips, visual aids (charts, boards, PPTs), timely feedback, multiple explanation methods, simplified teaching approaches, real-life examples, one-on-one assistance, and innovative ways of clarifying concepts.

In summary, the analysis indicates that both teachers and students hold high to very high perceptions of the use of scaffolding strategies in mathematics instruction. However, students perceive limited opportunities for interaction and articulation of their understanding, suggesting a potential area for improvement in fostering interactive learning environments.

**4.4 Perceptions on the Impact of Scaffolding in Teaching and Learning Mathematics**

The study analyzed both quantitative and qualitative data collected from mathematics teachers and students to assess their perceptions of the impact of scaffolding strategies in teaching and learning mathematics.

Table 7

*Teachers’ level of perception on impact of different scaffolding strategies*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | **Min** | **Max** | **Mean** | **SD** | **Level of Perception** |
| Activate Prior knowledge | 14 | 4.20 | 5.00 | 4.71 | .320 | Very High |
| Visual Scaffolding | 14 | 3.60 | 5.00 | 4.47 | .725 | Very High |
| Interactive scaffolding | 14 | 3.33 | 5.00 | 4.40 | .557 | Very High |
| Multiple ways | 14 | 3.00 | 5.00 | 4.48 | .584 | Very High |
| Math Talk and Questionings | 14 | 4.00 | 5.00 | 4.63 | .425 | Very High |
| Model and demonstration | 14 | 3.00 | 5.00 | 4.40 | .629 | Very High |
| **Average** | **14** | **3.63** | **5.00** | **4.53** | **.418** | **Very High** |

*(Note: 1.0 – 1.79 = Very Low/Strongly Disagree, 1.80 – 2.59 = Low/Disagree, 2.60 – 3.39 = Medium/Neutral, 3.40 – 4.19 = High/Agree, 4.20 – 5.00 = Very High/Strongly Agree)*

Table 8

*Teachers’ perception on impact of different scaffolding strategies*

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scaffolding Strategies** | **Items** | **N1** | **SD**  **%** | **D**  **%** | **N2**  **%** | **A**  **%** | **SA**  **%** | **M** | **SD** |
| Activate Prior knowledge | Checking the students’ understanding of the topic helps in knowing diversity of students in my class | 14 | 0 | 0 | 0 | 28.6 | 71.4 | 4.71 | .469 |
| Students’ prior knowledge on the topic enhances students’ learning through knowledge diffusion and exchanges of ideas | 14 | 0 | 0 | 0 | 35.7 | 64.3 | 4.64 | .497 |
| Students learn more readily when they connect what they are learning with what they already know | 14 | 0 | 0 | 7.1 | 7.1 | 85.7 | 4.79 | .579 |
| Preparing lesson according to different learning styles helps better learning | 14 | 0 | 0 | 0 | 14.3 | 85.7 | 4.86 | .363 |
| Knowing student’s prior knowledge help teaching appropriate concept | 14 | 0 | 0 | 0 | 42.9 | 57.1 | 4.57 | .514 |
| Visual Scaffolding | Visual mathematics facilitates higher-level thinking | 14 | 0 | 0 | 0 | 50 | 50 | 4.50 | .519 |
| Use of visual aids improves student’s engagement | 14 | 0 | 0 | 7.1 | 35.7 | 57.1 | 4.50 | .650 |
| Audio-visual aids help students to improve the listening and communication skills of mathematics concepts | 14 | 0 | 0 | 14.3 | 42.9 | 42.9 | 4.29 | .726 |
| The use of different teaching aids help student better retain and for longer duration of what they have been taught in the class | 14 | 0 | 0 | 0 | 35.7 | 64.3 | 4.64 | .497 |
| The examples and the environment that teaching aids creates enhances conceptual thinking and helps students to expand their horizons | 14 | 0 | 0 | 7.1 | 42.9 | 50 | 4.43 | .646 |
| Interactive scaffolding | Student understand math concept more in small interactive group | 14 | 0 | 0 | 7.1 | 50 | 42.9 | 4.36 | .726 |
| Peer assistant helps in understanding math concept better | 14 | 0 | 0 | 14.1 | 42.9 | 42.9 | 4.29 | .726 |
| Active learning, interaction, participation and collaborative are best ways of learning mathematics | 14 | 0 | 0 | 7.1 | 28.6 | 64.3 | 4.57 | .646 |
| Multiple ways | Teaching students with multiple strategies motivates students to work at solving problem | 14 | 0 | 0 | 0 | 28.6 | 71.4 | 4.71 | .469 |
| Teaching students with multiple ways give option for students to solve and understand the problem in better ways | 14 | 0 | 0 | 7.1 | 21.4 | 71.4 | 4.64 | .633 |
| As a teacher, I view myself as a facilitator | 14 | 0 | 0 | 21.4 | 35.7 | 42.9 | 4.00 | 1.177 |
| Use of multiple ways cater to individual learning capabilities and motivates learning | 14 | 0 | 0 | 7.1 | 28.6 | 64.3 | 4.57 | .646 |
| Model and demonstration | Modeling and demonstration provide opportunities for students to develop and practice mathematics-related skills | 14 | 0 | 0 | 7.1 | 42.9 | 50 | 4.43 | .646 |
| Modeling helps students communicate their understanding and interpretation of the mathematical problems | 14 | 0 | 0 | 7.1 | 50 | 42.9 | 4.36 | .633 |
| Mathematics modeling gives precision and direction for the solution of mathematics problems | 14 | 0 | 0 | 7.1 | 42.9 | 50 | 4.43 | .646 |
| Feedback and Questionings | Effective questioning encourages students to engage with their work | 14 | 0 | 0 | 0 | 35.7 | 64.3 | 4.64 | .497 |
| Effective questioning guides students in carrying out activities | 14 | 0 | 0 | 0 | 42.9 | 57.1 | 4.57 | .514 |
| Feedbacks help student recognize their error | 14 | 0 | 0 | 0 | 42.9 | 57.1 | 4.57 | .514 |
| Feedbacks help student recognize their strengths and areas of opportunities to work better | 14 | 0 | 0 | 0 | 28.6 | 71.4 | 4.71 | .469 |

*(Note: 1.0 – 1.79 = Very Low/Strongly Disagree, 1.80 – 2.59 = Low/Disagree, 2.60 – 3.39 = Medium/Neutral, 3.40 – 4.19 = High/Agree, 4.20 – 5.00 = Very High/Strongly Agree)*

The results in Table 7 indicate an overall very high perception (M=4.53, SD=.418) of the effectiveness of scaffolding strategies in teaching mathematics. Mathematics teachers strongly agreed that designing lessons to accommodate different learning styles enhances their understanding of students’ prior knowledge, enabling them to teach concepts more effectively.

Among the six scaffolding strategies, activating prior knowledge was rated the highest (M=4.71, SD=.320), followed by math talk and questioning (M=4.63, SD=.425). This suggests that activating students' prior knowledge before introducing new concepts has a more significant positive impact than using math talk and questioning in teaching mathematics

Table 9

*Students’ level of perception on impact of different scaffolding strategies*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | **N** | **Min** | **Max** | **Mean** | **SD** | **Level of Perception** |
| Activate Prior knowledge | 333 | 1.00 | 5.00 | 3.92 | .856 | High |
| Visual Scaffolding | 333 | 1.25 | 5.00 | 3.79 | .725 | High |
| Interactive scaffolding | 333 | 1.33 | 5.00 | 3.85 | .668 | High |
| Multiple ways | 333 | 1.50 | 5.00 | 3.88 | .695 | High |
| Math Talk and Questionings | 333 | 1.33 | 5.00 | 3.74 | .811 | High |
| Model and demonstration | 333 | 1.00 | 5.00 | 3.83 | .795 | High |
| **Average** | **333** | **1.62** | **5.00** | **3.84** | **.609** | **High** |

*(Note: 1.0 – 1.79 = Very Low/Strongly Disagree, 1.80 – 2.59 = Low/Disagree, 2.60 – 3.39 = Medium/Neutral, 3.40 – 4.19 = High/Agree, 4.20 – 5.00 = Very High/Strongly Agree)*

The analysis of students’ perceptions, as shown in Table 9, indicates an overall high impact (M=3.84, SD=.609) of different scaffolding strategies on learning mathematics. Students rated activating prior knowledge the highest (M=3.92, SD=.856), followed closely by multiple approaches (M=3.88, SD=.695).

More than 80% of students agreed that checking prior knowledge helps them connect previous and new knowledge. Additionally, about two-thirds of the students agreed that when teachers build on their prior knowledge, it prevents them from getting lost in new concepts and keeps them engaged in lessons.

The findings from both teachers and students demonstrate that scaffolding strategies have a strong positive impact on teaching and learning mathematics. Teachers perceive scaffolding strategies as highly effective, particularly in activating students’ prior knowledge and encouraging math talk and questioning. Students also recognize the benefits of scaffolding, particularly in making connections between existing and new knowledge, engaging in interactive learning, and using multiple learning strategies.

These results suggest that implementing scaffolding strategies in mathematics classrooms enhances student engagement, understanding, and problem-solving abilities, ultimately improving their overall learning experience.

**4.5 Impact of Scaffolding Strategies on Mathematics Learning**

The analysis of interview data from both mathematics teachers and students revealed similar findings to those obtained from quantitative data analysis. The use of scaffolding strategies has a positive impact on the teaching and learning of mathematics. The data analysis under this theme identified four key areas: (1) connection between previous and new knowledge, (2) enhancement of learning, (3) improvement in mathematics performance, and (4) motivation to learn.

*4.5.1 Connection Between Previous and New Knowledge*

One of the key benefits of scaffolding strategies, as reported by both teachers and students, is the improved connection between what students already know and new concepts they are learning.

For instance, Student 1 (S1) shared: "My teacher always asks about my understanding of a topic before teaching it and ensures that we grasp the concept well. They ask questions from previous topics related to the new topic, which helps me connect what I have already learned with what I am going to learn." Similarly, Student 2 (S2) stated that their teacher occasionally assessed their prior knowledge by asking students to write on the board or respond to questions related to previous lessons.

Mathematics teachers also highlighted that activating students’ prior knowledge is an essential scaffolding strategy that helps bridge their existing knowledge with new concepts. Teacher 1 (T1) commented: "It helps students understand new concepts faster."

Teacher 3 (T3) further elaborated: "It connects the lesson topic with what they already know. Students learn better when the lesson topic is linked to their prior knowledge, making it easier to comprehend."

*4.5.2 Enhancement of Learning*

Both teachers and students emphasized that scaffolding strategies enhance the teaching and learning of mathematics. For example, Student 2 (S2) explained: "My teacher uses video clips on a projector and even provides links so we can explore more. They also explain formulas in a simple way. Watching video clips and hearing different explanations of formulas helps me understand and learn better."

Additionally, students expressed that working together enhances their learning. Student 4 (S4) shared: "By asking questions and solving problems together with the teacher, I understand concepts better. I also enjoy working with my friends, which makes learning more engaging." Student 5 (S5) added that when teachers use different examples to explain a concept, it improves their understanding. Demonstration and modeling were highlighted as effective scaffolding strategies that facilitate better learning.

All students agreed that using multiple teaching methods is more effective than relying solely on lectures. They emphasized that multiple approaches help them grasp concepts more easily. For instance, Student 2 (S2) stated: "I always prefer teachers to explain formulas in a simpler way so they are easier to understand and memorize while practicing."

All participants agreed that constant scaffolding support from both teachers and peers significantly improves mathematics learning.

*4.5.3 Improvement in Mathematics Performance*

The analysis of interview data also revealed that scaffolding strategies contribute to better student performance in mathematics, as reflected in test and examination results.

For instance, one of the teacher interviewees shared: "When students receive timely scaffolding, such as activating prior knowledge, using different audio-visual aids, providing immediate feedback, and demonstrating problem-solving techniques, they understand concepts better, which greatly helps them perform well in exams and tests."

Both teachers and students acknowledged that the use of scaffolding strategies enhances mathematics learning and, consequently, improves students' performance.

*4.5.4 Motivation to Learn*

Most students (9 out of 11) expressed that although mathematics is often perceived as a difficult subject, they feel more motivated to learn when they receive timely support and guidance from teachers and high-achieving peers. They highlighted that group interactions provide immediate help when they struggle to understand concepts or solve problems.

All participants stated that they learn better when working in pairs or small groups. They explained that such interactions offer opportunities to share and discuss ideas, which fosters interest in mathematics.

For example, Student 6 (S6) shared: "When teachers and friends support me in different ways to learn mathematics, I feel encouraged to study it at home." Similarly, Student 4 (S4) stated: "I enjoy mathematics classes when teachers provide timely help. If a teacher is available to answer my questions and clarify my doubts, it motivates me to learn. Having a friendly teacher helps me understand concepts more effectively."

Moreover, students reported feeling more confident in solving mathematical problems when they receive help from teachers or peers. Student 3 (S3) noted: "When friends or teachers help me solve math problems, it motivates me because I realize that math can be easy, and I learn different ways to solve problems." Teachers also acknowledged the role of scaffolding in motivating students. Teacher 4 (T4) commented: "Interactive group learning provides students with opportunities to present their ideas, learn diverse perspectives, use simple language to understand better, and develop communication skills. This creates a conducive learning environment and motivates students to participate actively."

In addition, teacher 9 (T9) added that: "When students are taught multiple problem-solving methods, they can choose the one they find easiest to apply in exams and tests. This flexibility helps them get the correct answers and improves their grades."

The findings indicate that the use of different scaffolding strategies has numerous positive impacts on the teaching and learning of mathematics. These strategies facilitate connections between prior and new knowledge, enhance learning, improve performance, and increase motivation to study mathematics. The insights gained from this study highlight the importance of incorporating scaffolding techniques to support students in their mathematical learning journey.

**4.6 Challenges of Scaffolding**

This section presents the perceptions of mathematics teachers and students regarding the challenges of using scaffolding in teaching and learning mathematics.

*Students’ Perception*

Survey results indicate a high overall perception of challenges in receiving timely and adequate scaffolding (M=3.59, SD=1.09). The most significant challenge was the large classroom size, with 77.7% of students agreeing that it hindered individual support (M=3.96, SD=0.984). Conversely, the least concerning issue was the lack of resources (M=3.20, SD=1.186), suggesting a relatively minor impact on scaffolding effectiveness.

*Teachers’ Perception*

Teachers reported a very high perception of challenges (M=4.57, SD=0.609) in implementing scaffolding strategies. The most significant issue was the difficulty of providing individual attention in large classes (M=4.86, SD=0.363). Teachers also highlighted challenges in accurately assessing students' Zone of Proximal Development (ZPD) (M=4.57, SD=0.852) and the risk of misjudging it (M=4.29, SD=0.611).

*Thematic Analysis*

Findings from interviews identified two key themes:

1. Classroom Size and Diverse Learners:Both teachers and students reported that large class sizes and diverse learning abilities made it difficult to provide tailored scaffolding. Students noted that peers often struggled with concepts themselves, limiting their ability to assist others. Teachers echoed these concerns, emphasizing the difficulty of addressing individual learning needs.
2. Limited Time and Lack of Resources:The vast syllabus, limited instructional time, and insufficient resources were significant obstacles. Students expressed frustration over the lack of time for repeated explanations, while teachers cited time constraints in providing individualized support. Additionally, students found peer-assisted learning challenging due to their own study demands.

**4.7 Summary**

This chapter examined the use, impact, and challenges of scaffolding in mathematics classrooms based on teacher and student perceptions. Quantitative data revealed a very high perception level among teachers (M=4.22, SD=0.413) and a high perception level among students (M=3.84, SD=0.596). Teachers and students identified activating prior knowledge, visual scaffolding, group interaction, multiple representations, and modeling/demonstration as the most frequently used scaffolding strategies. They strongly agreed that scaffolding enhances learning by connecting prior and new knowledge, improving academic performance, increasing motivation, and fostering a positive attitude toward mathematics.

Despite its benefits, significant challenges remain. Large class sizes, diverse learning abilities, limited time, a vast syllabus, and resource constraints hinder effective scaffolding implementation. These findings underscore the need for strategies to optimize scaffolding while addressing practical challenges in the classroom.

**CHAPTER 5: DISCUSSION**

This study aimed to investigate the perceptions of mathematics teachers and students regarding scaffolding in teaching and learning, along with its impacts and challenges in Class IX mathematics classrooms. A mixed-method approach was used, with quantitative data analyzed using SPSS 22 and qualitative data analyzed thematically.

This chapter discusses the study’s findings in relation to existing literature.

**5.1 Teachers’ and Students’ Perceptions of Scaffolding in Mathematics Instruction**

Survey results revealed that teachers had a high perception of scaffolding strategies (M=4.22, SD=0.413), as did students (M=3.84, SD=0.596), indicating broad recognition of its benefits in enhancing engagement and understanding. These findings align with past studies which emphasis the role of scaffolding in improving teaching quality and fostering higher-order thinking (Yelland & Masters, 2007).

As per Clark & Graves (2005), the scaffolding strategies vary based on student needs and task complexity. Teachers in this study employed strategies such as activating prior knowledge, visual scaffolding, modeling, and feedback, consistent with existing literature (Van de Pol et al., 2010). Interestingly, students rated "multiple representations" as the most effective strategy, while teachers ranked it the lowest, possibly reflecting differences in learning preferences (Elmonayer, 2017).

Teachers consistently applied three key strategies: assessing prior knowledge, using visual aids, and employing questioning techniques, suggesting a structured approach to scaffolding in Samtse Dzongkhag classrooms.

**5.2 Impact of Scaffolding on Mathematics Learning**

The study found that 95% of teachers and over 70% of students perceived scaffolding as beneficial in improving learning experiences. Scaffolding was reported to enhance knowledge retention, engagement, motivation, and problem-solving skills, supporting findings from Lutz et al. (2006) and Bean & Patel (2002).

Additionally, scaffolding was found to reduce student anxiety and promote a supportive learning environment, aligning with Kusmaryono et al. (2020). Effective scaffolding has been shown to enhance student responsibility and motivation while minimizing cognitive load (Keebaugh et al., 2009), allowing for deeper engagement in complex mathematical tasks. Cognitive scaffolding strategies improve elementary students’ mathematical problem-solving abilities (O’callaghan & MacDonald, 2021).

The finding of the studies shows that use of scaffolding strategies has positive impacts on problem-solving skills of students, enhances interaction and motivate learning mathematics.

**5.3 Challenges in Implementing Scaffolding Strategies**

Despite its benefits, several challenges hinder effective scaffolding. Key issues included large class sizes, time constraints, extensive syllabi, and resource limitations. These findings align with previous studies, which cite the time-intensive nature of scaffolding and the difficulty of accurately assessing students' Zone of Proximal Development (ZPD) (Lipscomb et al., 2010; Vygotsky, 1978). Ineffective scaffolding may lead to misaligned instruction and reduced learning outcomes (Van de Pol et al., 2019).

Addressing these challenges is crucial to maximizing the effectiveness of scaffolding in mathematics education. Providing adequate resources, training, and manageable class sizes could enhance implementation.

**5.4 Summary**

This chapter discussed the study’s findings in relation to literature and research questions. The results indicate that mathematics teachers and students perceive scaffolding strategies positively, recognizing their role in improving engagement, motivation, and conceptual understanding. However, challenges such as time constraints, large class sizes, and resource shortages hinder effective implementation.

Teachers demonstrated a greater awareness of scaffolding techniques than students, suggesting the need for further student exposure to these strategies. Overall, this study highlights the importance of consistent scaffolding in mathematics instruction and the necessity of addressing its challenges to optimize learning outcomes.

**CHAPTER 6: CONCLUSION**

This chapter summarizes the study’s key findings, conclusions, limitations, and recommendations.

**6.1 Conclusion**

This study examined the perceptions of Mathematics teachers and students regarding scaffolding strategies, their impact, and the challenges faced in teaching and learning mathematics. The research included 333 Class IX students and 14 Mathematics teachers from four Middle Secondary Schools in Samtse Dzongkhag.

Descriptive analysis (Mean and Standard Deviation) was used to analyze survey data, while thematic analysis supported qualitative insights from interviews. The findings revealed a strong positive perception of scaffolding, with 90% of teachers and over 71% of students acknowledging its use in mathematics classrooms.

The study indicates that scaffolding enhances student motivation, learning, and performance by facilitating connections between prior and new knowledge. It also builds students’ confidence to tackle complex tasks and promotes proficiency. However, challenges such as large class sizes, diverse student needs, limited time, an extensive syllabus, misjudging students’ Zone of Proximal Development (ZPD), and resource constraints hinder effective implementation. Despite these challenges, the study underscores the significant benefits of scaffolding in Bhutanese mathematics classrooms.

**6.2 Limitations of the Study**

This study had certain limitations:

1. It lacked in-depth analysis of scaffolding strategies in real classroom settings, as no direct observations were conducted. Findings are based solely on teachers' and students’ perceptions rather than practical interventions.
2. The study was limited to one Dzongkhag, and its findings may not be generalizable to other schools in Bhutan.

**6.3 Recommendations**

Based on the findings, the study suggests the following recommendations:

**For Teaching and Learning**

1. Schools should provide structured professional development programs to train teachers on effectively integrating scaffolding strategies into daily mathematics lessons.
2. Teachers should integrate and implement different scaffolding strategies in their daily lesson plan to enhance student interaction, student participation and engagement.

**For Future Research**

1. Future studies should examine scaffolding strategies in different subjects and grade levels to determine their adaptability and impact across various learning environments.
2. Researcher should focus on how scaffolding can be customized for students with different learning needs, including those with learning difficulties or high-achieving students in Bhutanese context.
3. Future studies should adopt quasi-experimental designs with control and experimental groups to measure the direct impact of scaffolding on students’ mathematics achievement.

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**REFERENCES**

Abdu, R., Schwarz, B., & Mavrikis, M. (2015). Whole-class scaffolding for learning to solve mathematics problems together in a computer-supported environment. *ZDM Mathematis Education, 47*(7), 1163 – 1178. <https://doi.org/10/1007/s11858-015-0719-y>

Abune, A. A. (2019). Effects of peer scaffolding on students’ grammar proficiency and development. *International Journal of English Literature and Culture, 7*(5), 105 – 120. <https://doi.org/10.14662/IJELC2019.081>

Anghileri, J. (2006). Scaffolding practices that enhance mathematics learning*. Journal of Mathematics Teacher Education, 9*(1)*,* 33–52*.* <https://doi.org/10.1007/s10857-006-9005-9>

Bakker, A., Smit, J., & Wegerif, R. (2015). Scaffolding and dialogic teaching in mathematics education: introduction and review. *ZDM Mathematics Education, 47,* 1047 – 1065. <https://doi.org/10.1007/s11858-015-0738-8>

Bature, I. J., & Jibrin, A, G. (2015). The perception on preservice mathematics teachers on the role of scaffolding in achieving quality mathematics classroom instruction. *International Journal of Education in Mathematics, Science amd Technology, 3*(4), 275 – 287. <https://doi.org/10.18404/ijemst.76395>

BCSEA. (2013*). A Study of Student Achievements in English Literacy and Mathematics  
Literacy at Grade X* (NEA Technical report 2013-2014). Bhutan Council for School Examination and Assessment.

Belland, B. R., Kim, C., & Hannafin, M. J. (2013). A Framework for Designing Scaffolds That Improve Motivation and Cognition. *Educational Psychologist, 48*(4),243–270. <https://doi.org/1080/00461520.2013.838920>

Bikmaz, F. H., Çelebi, Ö., Ata, A., Özer, E., Soyak, Ö., & Reҫber, H. (2010). Scaffolding strategies applied by student teachers to teach mathematics. *The International Journal of Research in Teacher Education, 1*(3), 25 – 36. Retrieved from <https://dergipark.org/tr/en/pub/ijrte/issue/8556/106211>

Creswell, J. W. (2012). *Educational research: Planning, conducting and evaluating quantitative and qualitative research* (4th ed.). Boston: Pearson Education.

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, Quantitative, and Mixed Methods Approaches* (5th ed.). SAGE.

Dolma, P., Nutchey, D., Watters, J. J., & Chandra, V. (2017). Investigating the alignmemt of Bhutanese mathematics teachers’ planned approaches within the context of reformed curriculum. *International Journal of Science and Mathematics Education, 16*(3), 581 – 602. <https://doi.or/10.1007/s10763-016-9791-1>

Dolma, P. (2016). *Investigating Bhutanese Mathematics teacher’s beliefs and practices in the context of curriculum reform* (PhD Dissertation). Queensland University of Technology, Brisbane, Australia.

Finali, Z., Rulysansah, A., & Hutama, F. S. (2023). Multiple Intelligence-based Instructor Scaffolding Strategies in Digital game-assisted Mathematics Instruction. *AIP Conference Proceedings,* 2679, 06005. https://doi.org/10.1063/5.0111274

Frederick, M. L., Courtney, S., & Caniglia, J. (2014). Helpfrom my friedns: Scaffolding techniques in problem solving. *Investigations In Mathematics Learning, 7*(2), 21 – 32. <http://dx.doi.org/10.1080/24727466.2014.11790340>

Gonulal, T., & Loewen, S. (2018). Scaffolding Technique. *The TESOL Encyclopedia of English Language Teaching,* 1–5. <https://doi.org/10.1002/9781118784235.eelt0180>

Goos, M. (1999). Scaffolds: a sociocultural approach to reforming mathematics teaching and teacher education. *Mathematics Teacher Education & Development*, *1*(1999), 4 – 21. <https://search.informit.org/doi/10.3316/aeipt.99324>

**Gummesson, C., & Hammarlund, C. S. (2024).** Scaffolding structures to promote widening participation in higher education: A meta-ethnographic analysis of qualitative studies. Physical Therapy Reviews, 29(4), 167–176. <https://doi.org/10.1080/10833196.2024.2392066>

Holton, D., & Clarke, D. (2006). Scaffolding and metacognition. *International Journal of Mathematical Education in Science and Technology, 37*(2), 127–143. <https://doi.org/10.1080/00207390500285818>

Jalandoni, J.F., & Futalan, M.C. (2024). Scaffolding students’ difficulties in addition and subtraction of integers through game-based instruction. *Journal of Interdisciplinary Perspectives,* *2*(7), 195-203. https://doi.org/10.69569/jip.2024.0143

Kang, H., Thompson, J., & Windschitl, M. (2014). Creating Opportunities for Students to Show What They Know: The Role of Scaffolding in Assessment Tasks. *Science Education, 98*(4), 674–704. <https://doi.org/10.1002/sce.21123>

**Kong, Q., & Li, Y. (2023).** Scaffolding effects of worked examples in learning mathematics: A meta-analysis. Educational Psychology Review, 35(2), 345–375. <https://doi.org/10.1007/s10648-023-09635-2>

Kusmaryono, I., Gufron, A., & Rusdiantoro, A. (2020). Effectiveness of Scaffolding Strategies in Learning Against Decrease in Mathematics Anxiety Level. *Numerical: Journal Matematika Dan Pendidikam Matematika, 4*(1), 13 – 22. <https://doi.org/10.25217/numerical.v4i1.770>

Larkin, M. J. (2001). Providing support for student independence through scaffolding instruction. *TEACHING Exceptional Children, 34*(1), 30 - 34. <https://doi.org/10.1177/004005990103400104>

**Liang, C.-P., & Tsai, M.-J. (2021).** Investigate the effectiveness of single and multiple representational scaffolds on mathematics problem solving: Evidence from eye movements. Interactive Learning Environments, 29(6), 839–854. <https://doi.org/10.1080/10494820.2020.1799739>

Lutz, S. L., Guthrie, J. T., & Davis, M. H. (2006). Scaffolding for engagement in learning:  
An observational study of elementary school reading instruction. *Journal of Educational Research, 100*(1), 3 –20. <https://doi.org/10.3200/JOER.100.1.3-20>

Machmud, T. (2011, July 21 – 23). Scaffolding strategy in mathematics learning. In *Proceeding international seminar and the fourth national conference on mathematics education* (pp.429 – 440).

**O'Callaghan, C., & MacDonald, M. (2021).** The effectiveness of cognitive scaffolding in an elementary mathematics classroom. Educational Technology Research and Development, 69(1), 123–140. <https://doi.org/10.1007/s11423-020-09823-3>

Pentimonti, J. M., Justice, L. M., Yeomans-Maldonado, G., McGinty, A. S., Slocum, L., & O’Connel, A. (2017). Teachers’ Use of High- and Low- Support Scaffolding Strategies to Differentiate Language Instruction in High-Risk/Economically Disadvantaged Setting. *Journal of Early Intervention,* 1 – 22. <https://doi.org/10.1177/1053815117700865>

Puntambekar, S., & Hübscher, R. (2005). Tools for scaffolding students in a complex learning environment: What have we gained and what have we missed?. *Educational Psychologist, 40*(1), 1–12. <https://doi.org/10.1207/s15326985ep4001_1>

Shabani, K. (2010). Vygotsky’s Zone of Proximal Development: Instructional Implications and Teachers’ Professional Development. *3*(4), 237 – 248. [www.ccsenet.org/elt](http://www.ccsenet.org/elt)

Simons, K. D., & Klein, J. D. (2006). The Impact of Scaffolding and Student Achievement Levels in a Problem-based Learning Environment. *Instructional Science, 35*(1), 41 – 72. <https://doi.org/10.1007/s11251-006-9002-5>

Siyepu, S. (2013). The zone of proximal development in the learning of mathematics. *33*(2), 1 – 13. <https://doi.org/10.15700/saje.v33n2a714>

Slavin, R.E. (1997). *Educational Psychology: Theory and Practice (5th Edition)*. Allyn and Bacon

Sutiarso, S., Coesamin, M., & Nurhanurawati. (2018). The effect of various media scaffolding on increasing understanding of students’ geometry concepts. *Journal on Mathematics Education, 9*(1), 95 – 102. <https://files.eric.ed.gov/fulltext/EJ1173673.pdf>

Vacca, J. (2008). Using scaffolding techniques to teach a social studies lesson about Buddha to sixth graders. *Journal of Adolescent and Adult Literacy*, *51*(8), 652–658. <https://doi.org/10.1598/JAAL.51.8.4>

**Van de Pol, J., & Elbers, E. (2024).** Scaffolding small groups at the group level: Improving the scaffolding of small groups during mathematical discussions. International Journal of Science and Mathematics Education, 22(7), 1601–1620. <https://doi.org/10.1007/s10763-021-10123-3>

Van de Pol, J., Mercer, N., & Volman, M. (2018). Scaffolding student understanding in small-group work: students’ uptake of teacher support in subsequent small-group interaction. *Journal of the Learning Sciences,* 1–34. <https://doi.org/10.1080/10508406.2018.1522258>

Van de Pol, J., Volman, M., Oort, F., & Beishuizen, J. (2015). The effects of scaffolding in the classroom: support contingency and student independent working time in relation to student achievement, task effort and appreciation of support. *Instructional Science, 43*(5), 615–641. <https://doi.org/10.1007/s11251-015-9351-z>

Van de Pol, J., Volman, M., Oort, F., & Beishuizen, J. (2013). Teacher scaffolding in small-group work: an intervention study. *Journal of the Learning Sciences, 23*(4), 600–650*.* <https://doi.org/10.1080/10508406.2013.805300>

Van de Pol, J., Volman, M., & Beishuizen, J. (2011). Promoting teacher scaffolding in small-group work: A contingency perspective. *Teaching and Teacher Education, 28*(2), 193–205. <https://doi.org/10.1016/j.tate.2011.09.009>

Van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher–student interaction: a decade of research. *Educational Psychology Review, 22*(3), 271–296. <https://doi.org/10.1007/s10648-010-9127-6>

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Wood, D., Bruner, J. S., & Ross, G. (1976). The role of tutoring in problemsolving. *Journal of Child Psychology and Psychiatry, 17*(2), 89–100. [https://doi.org/10.1111/j.1469-7610. 1976.tb00381.x](https://doi.org/10.1111/j.1469-7610.%201976.tb00381.x)