
THE ROLE OF CONSTRUCTIVIST TEACHING IN DEVELOPING MATHEMATICAL PROBLEM-SOLVING SKILLS

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Article Received: 20 August 2026

Article Revised: 08 September 2026

Published on: 28 September 2026

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DOI: <https://doi-doi.org/101555/ijrpa.7107>

1. ABSTRACT

Mathematical problem-solving is an essential component of mathematics education as it enables learners to apply mathematical concepts, reasoning, and strategies to unfamiliar situations. Constructivist teaching provides a learner-centred approach in which students actively construct knowledge through prior experiences, exploration, discussion, collaboration, and reflection. The present paper examines the role of constructivist teaching in developing mathematical problem-solving skills through a review of existing literature. It focuses on how constructivist principles and classroom practices can support learners in developing conceptual understanding, mathematical reasoning, strategic thinking, and confidence in solving mathematical problems. The reviewed literature suggests that constructivist approaches can provide meaningful opportunities for learners to explore multiple solution strategies, communicate mathematical ideas, and connect new concepts with prior knowledge. However, effective implementation requires appropriate teacher preparation, suitable learning activities, adequate classroom time, and supportive learning environments. As a literature-based study, this paper does not present original empirical data but synthesizes existing research to examine the educational significance of constructivist mathematics teaching and its potential contribution to the development of mathematical problem-solving skills.

KEYWORDS: Constructivist Teaching, Mathematical Problem-Solving, Mathematics Education, Learner-Centred Learning, Mathematical Reasoning.

2. INTRODUCTION

Mathematics education aims not only to develop computational skills but also to enable learners to understand concepts, reason mathematically, and apply their knowledge to unfamiliar situations. Among these abilities, mathematical problem-solving is particularly important because it requires learners to interpret problems, select appropriate strategies, make connections, evaluate solutions, and communicate their reasoning. Effective problem-solving therefore involves more than recalling formulas or following predetermined procedures. Research in mathematics education has emphasized the importance of meaningful problem situations and appropriate teacher intervention in developing learners' mathematical understanding and problem-solving abilities. Constructivism provides an important theoretical perspective for understanding how learners develop mathematical knowledge. From a constructivist perspective, learners are not passive recipients of information; rather, they actively construct and reorganize knowledge through their experiences and interactions. In mathematics education, this perspective gives importance to learners' prior knowledge, exploration, discussion, reflection, and the interpretation of mathematical ideas. Constructivist mathematics classrooms therefore encourage students to engage actively with mathematical tasks and to develop understanding rather than merely reproduce procedures.

Mathematical problem-solving provides a particularly suitable context for constructivist learning because problems can create opportunities for learners to explore different approaches and construct their own mathematical strategies. Instead of presenting a single prescribed procedure, teachers can encourage students to analyse a problem, make conjectures, use representations, compare different solution methods, and justify their conclusions. Such practices can support deeper conceptual understanding and mathematical reasoning. Research examining constructivist perspectives in mathematics problem-solving has highlighted both the opportunities offered by such approaches and the importance of teachers' knowledge, beliefs, and classroom decisions in their effective implementation. The teacher's role is also significant in a constructivist mathematics classroom. Rather than functioning primarily as a transmitter of mathematical procedures, the teacher acts as a facilitator who observes students' thinking, asks purposeful questions, provides appropriate guidance, and creates opportunities for students to explain and refine their reasoning. At the same time, constructivist teaching does not imply that learners should be left without guidance. Research indicates that effective teacher support and sensitivity to students' existing mathematical thinking are important components of constructivist-oriented

instruction. Despite the potential of constructivist teaching, its implementation can present challenges. Teachers may need to adapt their instructional beliefs, classroom practices, learning tasks, and assessment approaches. Classroom time, curriculum expectations, teacher preparedness, and differences in learners' existing knowledge may also influence implementation. Research on teachers' experiences with constructivist mathematics teaching has identified both opportunities and challenges associated with translating constructivist principles into actual problem-solving classrooms.

Against this background, the present study examines the role of constructivist teaching in developing mathematical problem-solving skills. As a literature-based study, it seeks to synthesize existing research on constructivist mathematics teaching and problem-solving and to identify its potential contribution to learners' conceptual understanding, reasoning, strategic thinking, and active participation in mathematics learning.

3. Objectives of the Study

The present study aims to examine the role of constructivist teaching in developing mathematical problem-solving skills. The specific objectives are:

1. To examine the concept and principles of constructivist teaching in mathematics education.
2. To explore the role of constructivist teaching in developing learners' mathematical problem-solving skills.
3. To examine the contribution of constructivist approaches to mathematical reasoning and conceptual understanding.
4. To analyse the role of learner participation, prior knowledge, exploration, and collaboration in constructivist mathematics learning.
5. To identify the major challenges associated with implementing constructivist teaching in mathematics classrooms.
6. To suggest appropriate educational implications for strengthening mathematical problem-solving through constructivist teaching.

4. METHODOLOGY

4.1 Research Design

The present study adopts a descriptive and analytical literature-based research design. The study does not involve primary data collection, experimental intervention, or field-based

investigation. Instead, it examines and synthesizes existing research on constructivist teaching and mathematical problem-solving skills.

4.2 Sources of Literature

Relevant literature was drawn from peer-reviewed research articles, review papers, academic publications, and scholarly databases, including ERIC, Google Scholar, and PubMed, wherever relevant to the topic. Priority was given to literature addressing constructivist mathematics teaching, mathematical problem-solving, conceptual understanding, mathematical reasoning, and learner-centred approaches.

4.3 Selection and Analysis of Literature

Literature was selected on the basis of its relevance to the objectives of the study. The selected studies were critically examined and organized around major themes, including constructivist approaches to mathematics teaching, problem-solving skills, learner participation, teacher facilitation, mathematical reasoning, and classroom implementation. The findings were synthesized thematically to identify common patterns, educational implications, and areas requiring further research.

4.4 Limitations of the Study

As a literature-based study, the present research does not provide original empirical data or statistical estimates. Its findings are dependent on the quality, scope, and limitations of the existing literature. Therefore, the conclusions are presented as a synthesis of available research rather than as evidence from a newly conducted empirical investigation.

5. Review of Related Literature

5.1 Constructivist Teaching in Mathematics Education

Constructivism views learning as an active process in which learners construct knowledge by connecting new experiences with their existing understanding. In mathematics education, this perspective shifts the focus from transmission of mathematical rules towards learners' active engagement with mathematical ideas. Constructivist classrooms provide opportunities for students to explore, question, discuss, represent, and interpret mathematical concepts rather than simply memorize procedures. Research on mathematics teaching has emphasized that learners' existing knowledge plays an important role in the development of new mathematical understanding. Effective instruction therefore requires teachers to identify students' existing ideas and create learning experiences that help them reorganize and extend those ideas.

5.2 Constructivist Teaching and Mathematical Problem-Solving

Mathematical problem-solving provides a meaningful context for constructivist learning because learners are required to use existing knowledge while developing strategies for unfamiliar situations. Constructivist teaching encourages students to analyse problems, generate possible approaches, test their ideas, and evaluate solutions. Rather than presenting one fixed procedure, teachers can provide problems that allow multiple solution strategies. Such tasks can encourage students to explain how and why a particular strategy works. This process can contribute to conceptual understanding and help learners become more flexible in their mathematical thinking.

5.3 Role of Prior Knowledge and Experience

Prior knowledge is an important element of constructivist learning. Learners approach new mathematical problems with existing concepts, experiences, assumptions, and strategies. When new information is connected with this existing knowledge, learners may develop more meaningful and lasting understanding. In problem-solving, prior knowledge helps students identify relevant information, select appropriate mathematical concepts, and connect different representations. However, prior knowledge may also include misconceptions. Constructivist teaching therefore provides opportunities for learners to examine their ideas, identify inconsistencies, and reconstruct their understanding through mathematical exploration and discussion.

5.4 Collaborative Learning and Mathematical Reasoning

Constructivist mathematics teaching can provide opportunities for learners to work collaboratively and communicate their mathematical thinking. Through discussion with peers, students encounter different strategies and interpretations of the same problem. Comparing these approaches can encourage them to justify their reasoning and reconsider their own solutions. Collaborative problem-solving may therefore support mathematical communication, reasoning, and reflection. The teacher's role is to facilitate productive discussion and ensure that collaboration remains focused on mathematical thinking rather than simply on obtaining an answer.

5.5 Teacher's Role in a Constructivist Mathematics Classroom

In a constructivist classroom, the teacher functions primarily as a facilitator of learning. Instead of immediately providing solutions, the teacher can use questions, prompts, examples, representations, and feedback to guide students' thinking. Effective facilitation requires the teacher to understand students' mathematical ideas and respond appropriately to their reasoning. The teacher must also create classroom conditions in which students feel

comfortable explaining their approaches, making mistakes, asking questions, and considering alternative solutions.

5.6 Research Gap

Existing literature provides substantial theoretical and empirical support for learner-centred and constructivist approaches in mathematics education. However, the effectiveness of constructivist teaching may vary according to learners' characteristics, classroom conditions, teacher preparedness, instructional practices, and the nature of mathematical tasks. Further research is needed to examine how specific constructivist classroom practices contribute to different dimensions of mathematical problem-solving, particularly strategic thinking, reasoning, and the ability to apply mathematical knowledge in unfamiliar contexts.

6. DISCUSSION

The reviewed literature indicates that constructivist teaching can provide a meaningful framework for developing mathematical problem-solving skills. Its emphasis on active learning, prior knowledge, exploration, discussion, and reflection creates opportunities for learners to engage with mathematical problems beyond the mechanical application of formulas and procedures.

6.1 Constructivist Teaching and Problem-Solving Skills

Constructivist teaching encourages learners to understand a problem before attempting to solve it. Students can identify relevant information, develop possible strategies, test their ideas, and evaluate the reasonableness of their solutions. This process can strengthen important problem-solving skills such as analysis, strategy selection, logical reasoning, and reflection.

6.2 Conceptual Understanding and Mathematical Reasoning

Problem-solving becomes more meaningful when learners understand the mathematical concepts underlying a procedure. Constructivist learning allows students to connect new concepts with prior knowledge and experiences. Exploring multiple representations and solution strategies can help learners understand mathematical relationships rather than simply remember rules. Constructivist classroom discussions may also strengthen mathematical reasoning. When students are asked to explain why a strategy works, compare different solutions, or justify an answer, they are encouraged to think critically about mathematical ideas.

6.3 Active Participation and Learner Autonomy

A major contribution of constructivist teaching is the active involvement of learners in the learning process. Instead of receiving solutions directly from the teacher, students are encouraged to investigate problems and construct possible solutions. Such participation can promote confidence, independence, and willingness to engage with challenging mathematical tasks. Open-ended problems can be particularly useful because they may allow students to reach a solution through different methods. This can help learners recognize that mathematical problem-solving is not always limited to a single procedure.

6.4 Role of the Teacher

The effectiveness of constructivist teaching depends substantially on the teacher's ability to facilitate meaningful mathematical learning. The teacher needs to design appropriate problems, identify learners' existing understanding, ask purposeful questions, provide timely support, and encourage students to explain their reasoning. Constructivist teaching therefore does not mean that the teacher becomes passive. Instead, the teacher's role changes from primarily delivering information to guiding learners' mathematical thinking and helping them develop increasingly sophisticated strategies.

6.5 Challenges in Implementation

Despite its potential benefits, constructivist mathematics teaching may face practical challenges. Teachers may have limited instructional time, large classes, examination-oriented expectations, or insufficient resources for implementing exploratory activities. Differences in learners' prior knowledge may also make classroom facilitation more demanding. Another challenge is that constructivist activities require careful planning. Simply allowing students to work independently does not automatically result in meaningful mathematical learning. Effective implementation requires well-designed tasks, appropriate teacher guidance, productive classroom discussion, and assessment practices that value reasoning as well as final answers.

Overall, constructivist teaching can contribute to the development of mathematical problem-solving when its principles are translated into purposeful classroom practices. Its effectiveness depends not only on the theoretical approach but also on how teachers design, facilitate, and assess mathematical learning experiences.

7. Educational Implications

The findings of the reviewed literature have several implications for mathematics teaching and teacher education.

1. Mathematics teaching should emphasize understanding rather than memorization. Learners should be provided with opportunities to understand concepts and apply them in meaningful problem situations.
2. Teachers should use open-ended and challenging mathematical problems. Such tasks can encourage learners to explore different strategies, compare solutions, and justify their reasoning.
3. Prior knowledge should be considered during instruction. Teachers should identify learners' existing understanding and misconceptions before introducing new mathematical concepts.
4. Classroom interaction should be encouraged. Discussion, peer collaboration, questioning, and explanation can help learners communicate and refine their mathematical thinking.
5. Teachers should act as facilitators of learning. Instead of immediately providing solutions, teachers should use appropriate questions, hints, representations, and feedback to guide learners towards solutions.
6. Teacher education programmes should include constructivist mathematics practices. Pre-service and in-service teachers should receive opportunities to design and implement problem-solving activities based on constructivist principles.
7. Assessment should include mathematical reasoning. Evaluation should consider not only whether students obtain the correct answer but also how they interpret problems, select strategies, justify solutions, and reflect on their approaches.

Overall, constructivist teaching can contribute to more meaningful mathematics learning when supported by appropriate tasks, effective teacher facilitation, active learner participation, and assessment practices that value mathematical thinking.

8. CONCLUSION

The present literature-based study examined the role of constructivist teaching in developing mathematical problem-solving skills. The reviewed literature suggests that constructivist teaching can provide learners with meaningful opportunities to actively engage with mathematical problems, connect new knowledge with prior understanding, explore different solution strategies, and communicate their mathematical reasoning. Constructivist mathematics teaching moves beyond the simple transmission of rules and procedures by encouraging learners to investigate, question, discuss, and reflect on mathematical ideas. Such practices can support conceptual understanding, mathematical reasoning, strategic thinking, and learner autonomy. The teacher plays an important role as a facilitator by

designing appropriate learning experiences, asking purposeful questions, providing guidance, and responding to learners' mathematical thinking. However, successful implementation depends on factors such as teacher preparedness, classroom conditions, available instructional time, learner diversity, curriculum expectations, and appropriate assessment practices. Constructivism should therefore not be viewed as merely allowing students to discover answers independently; it requires carefully planned learning experiences supported by effective teacher guidance.

Overall, constructivist teaching has considerable educational relevance for mathematics classrooms, particularly when the aim is to develop learners who can understand mathematical ideas, approach unfamiliar problems strategically, justify their solutions, and apply mathematics meaningfully in different situations.

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