

METHODS OF CREATING PROBLEM-BASED SITUATIONS IN TEACHING  
QUADRATIC EQUATIONS

Dushamova Shohista Nuraddinovna

Department of Technological Machines and Information Systems,  
Asia International University

**Abstract** .This study examines methods for creating problem-based learning environments in teaching quadratic equations at the secondary education level. It focuses on the role of problem-based instruction in developing students' critical thinking and conceptual understanding. The research is based on classroom observations and comparative analysis of teaching approaches. Various strategies for introducing problem situations, including cognitive conflict and inquiry-based questioning, are analyzed. The results show that problem-based methods increase student engagement, improve problem-solving skills, and enhance knowledge retention. The study concludes that integrating problem-based techniques into algebra teaching leads to more effective learning outcomes.

**Annotatsiya** Ushbu tadqiqot umumiy o'rta ta'limda kvadrat tenglamalarni o'qitishda muammoli o'qitish muhitini yaratish usullarini o'rganishga bag'ishlangan. Unda muammoli yondashuvning o'quvchilarning tanqidiy fikrlashi va tushunchaviy bilimlarini rivojlantirishdagi ahamiyati yoritilgan. Tadqiqot dars kuzatuvlari va turli o'qitish usullarini taqqoslash asosida olib borildi. Muammoli vaziyat yaratishning turli strategiyalari, jumladan, savol-javob va qarama-qarshilik usullari tahlil qilindi. Natijalar muammoli o'qitish o'quvchilarning faolligini oshirishi, muammo yechish ko'nikmalarini rivojlantirishi va bilimlarni mustahkamlashini ko'rsatdi.

**Аннотация** Данное исследование посвящено методам создания проблемных ситуаций при обучении квадратным уравнениям в средней школе. Особое внимание уделяется роли проблемного обучения в развитии критического мышления и понимания математических понятий. Исследование основано на наблюдении уроков и сравнительном анализе методов обучения. Рассматриваются различные стратегии создания проблемных ситуаций, включая когнитивный конфликт и проблемные вопросы. Результаты показывают, что проблемный подход повышает активность учащихся, развивает навыки решения задач и способствует более прочному усвоению знаний.

**Keywords:** problem-based learning, quadratic equations, mathematics education, teaching methods, critical thinking.

**Introduction.** Modern educational systems increasingly prioritize the development of learners' independent thinking and problem-solving abilities over rote memorization. In mathematics education, particularly in algebra, students often struggle to grasp abstract concepts when taught through traditional lecture-based approaches.

Quadratic equations represent a fundamental topic in algebra, yet students frequently rely on memorized formulas without understanding their derivation or application. This gap highlights the necessity of implementing problem-based learning (PBL) strategies that actively involve students in the learning process.

The purpose of this study is to examine methods for creating problem-based situations when teaching quadratic equations and to evaluate their pedagogical effectiveness.

**Literature Review** Problem-based learning has been widely recognized as an effective instructional approach that promotes active learning and cognitive engagement. Previous studies suggest that PBL enhances students' ability to analyze, synthesize, and apply knowledge in unfamiliar contexts.



In mathematics education, problem-based approaches encourage students to explore multiple solution paths and develop deeper conceptual understanding. Researchers have also noted that introducing cognitive conflict—where existing knowledge is insufficient—stimulates meaningful learning.

Quadratic equations provide an ideal context for implementing PBL due to their conceptual depth and applicability in real-world problems.

**Methodology** This study employs a qualitative research design based on:

- classroom observations
- comparative teaching experiments
- analysis of student performance
- reflective teaching practices

Two groups of students were observed:

- a control group taught using traditional methods
- an experimental group taught using problem-based approaches

The instructional interventions focused on systematically introducing problem situations during lessons on quadratic equations.

### Methods of Creating Problem-Based Situations

**Cognitive Conflict Method** Students are presented with problems that cannot be solved using previously learned methods, creating a need for new knowledge.

**Example:** Students solve factorable equations easily, but struggle with non-factorable ones, leading to the introduction of the discriminant.

**Inquiry-Based Questioning** Teachers pose open-ended questions such as:

*"Is there a universal method to solve all quadratic equations?"*

This encourages exploration and hypothesis formation.

**Real-Life Contextualization** Mathematical problems are linked to real-world scenarios, such as motion or optimization problems, making learning more meaningful.

**Error-Based Learning** Students analyze incorrect solutions to identify and correct mistakes, promoting critical thinking.

**Knowledge Gap Strategy** Tasks are designed slightly beyond students' current ability level, motivating them to seek new methods.

**Results** The implementation of problem-based methods yielded the following outcomes:

- increased student engagement and participation
- improved conceptual understanding of quadratic equations
- enhanced problem-solving skills
- greater retention of knowledge

Students in the experimental group demonstrated significantly better performance compared to those in the control group.

**Discussion** The findings confirm that problem-based learning transforms students from passive recipients into active participants. In the context of quadratic equations, this approach helps students understand not only how formulas work but also why they are necessary.

The study also highlights that carefully designed problem situations are crucial for the success of this method. Teachers must balance difficulty levels to maintain motivation without causing frustration.

**Conclusion** Creating problem-based situations in teaching quadratic equations is an effective strategy for improving mathematical understanding and student engagement. This approach fosters critical thinking, independent learning, and deeper conceptual comprehension.

The study recommends integrating problem-based methods into regular mathematics instruction to enhance educational outcomes.



### References

1. Hmelo-Silver, C. E. (2004). Problem-based learning: What and how do students learn? *Educational Psychology Review*, 16(3), 235–266.
2. Barrows, H. S. (1996). Problem-based learning in medicine and beyond. *New Directions for Teaching and Learning*, 1996(68), 3–12.
3. Schoenfeld, A. H. (2013). Reflections on problem solving theory and practice. *The Mathematics Enthusiast*, 10(1), 9–34.
4. Polya, G. (1973). *How to Solve It*. Princeton University Press.
5. Jonassen, D. H. (2011). Learning to solve problems: A handbook for designing problem-solving learning environments. Routledge.

