

Teaching Problem Solving In Mathematics

Teaching Problem Solving in Mathematics: Unlocking Critical Thinking Skills **teaching problem solving in mathematics** is much more than guiding students through equations or formulas. It's about nurturing a mindset that embraces challenges, thinks critically, and applies knowledge creatively. When students learn how to approach problems effectively, they gain skills that transcend the classroom and empower them in everyday life. This article explores the art and science of teaching problem solving in mathematics, offering insights and practical strategies to make this essential skill accessible and engaging.

Why Focus on Teaching Problem Solving in Mathematics?

Mathematics is often seen as a set of rules to memorize, but true mathematical understanding emerges through problem solving. By focusing on problem solving, educators help students:

- Develop deeper conceptual understanding rather than rote memorization.
- Foster resilience and perseverance when facing difficulties.
- Enhance logical reasoning and critical thinking.
- Connect math concepts to real-world situations.
- Build confidence in their ability to tackle unfamiliar challenges.

In essence, problem solving transforms math from a static subject into a dynamic process of discovery.

Essential Components of Effective Problem Solving Instruction

Teaching problem solving in mathematics requires a thoughtful approach that goes beyond presenting problems for students to solve. Here are some crucial elements that make instruction effective and meaningful.

Encouraging a Growth Mindset

Students often view math as intimidating or believe they're simply "not good at it." Instilling a growth mindset—the belief that abilities can improve with effort—is foundational. When students understand that struggle is part of learning, they become more willing to engage with challenging problems and less likely to give up. Teachers can promote this by:

- Praising effort and strategies rather than innate talent.
- Sharing stories of mathematicians who overcame difficulties.
- Modeling persistence and positive attitudes toward mistakes.

Teaching Problem-Solving Strategies

Problem solving is not just guessing answers; it involves deliberate strategies. Introducing students to a variety of approaches equips them to tackle diverse problems. Some widely effective strategies include:

- **Understanding the problem:** Restating the problem in one's own words.
- **Devising a plan:** Choosing suitable methods such as drawing diagrams, making tables, or working backwards.
- **Carrying out the plan:** Executing calculations carefully.
- **Reviewing and reflecting:** Checking answers and considering alternative solutions.

Explicitly teaching these steps helps students become more organized and confident problem solvers.

Integrating Real-World Contexts

Connecting math problems to real-life scenarios makes learning relevant and engaging. Whether it's budgeting money, measuring ingredients, or planning travel routes, real-world contexts:

- Help students see the value and application of math.
- Stimulate interest by linking math to their experiences.
- Encourage creative thinking by presenting open-ended problems.

Teachers can design problems that relate to students' lives, making abstract concepts concrete.

Practical Techniques for Teaching Problem Solving in Mathematics

Moving from theory to practice, how can educators effectively cultivate problem-solving skills in their classrooms?

Use Collaborative Learning

Encouraging students to work in pairs or groups fosters discussion and exposes them to different perspectives. Collaborative problem solving allows learners to:

- Articulate their thought processes.
- Learn from peers' strategies.
- Develop communication and teamwork skills.

Group activities can be structured so that each student contributes uniquely, ensuring engagement.

Incorporate Open-Ended Problems

Unlike traditional exercises with a single correct answer, open-ended problems invite multiple solutions or methods. These problems stimulate creativity and deeper exploration. For example:

- "Find all possible ways to divide 12 apples among 4 friends."
- "Create your own word problem involving fractions."

Such tasks encourage students to justify their reasoning and explore alternatives.

Leverage Technology and Visual Tools

Digital apps, interactive whiteboards, and virtual manipulatives can bring problem solving to life. Visual aids like graphs, number lines, and geometric models make abstract ideas tangible. Using technology:

- Engages different learning styles.
- Offers immediate feedback.
- Provides dynamic environments to experiment with concepts.

Teachers should integrate these tools thoughtfully to complement traditional instruction.

Assessing Problem Solving Skills

Assessment in problem solving should capture students' thinking processes, not just final answers. Some effective methods include:

- **Written explanations:** Asking students to describe how they solved a problem.
- **Think-aloud protocols:** Observing students as they verbalize their reasoning.
- **Portfolio assessments:** Collecting a range of problem-solving tasks over time.
- **Performance tasks:** Realistic challenges that require applying multiple skills.

By focusing on reasoning and strategy, educators can better understand and support individual growth.

Providing Constructive Feedback

Feedback should be timely, specific, and focused on strategies rather than correctness alone. For instance:

- "I like how you broke the problem into smaller parts."
- "Have you considered drawing a diagram to visualize this?"
- "Check if your answer makes sense in the context of the problem."

Encouraging reflection helps students internalize lessons and build self-regulation.

Common Challenges and How to Overcome Them

Teaching problem solving in mathematics is rewarding but can be challenging. Recognizing common hurdles allows teachers to adapt their approaches.

Student Anxiety and Math Phobia

Many learners feel anxious about math, which can hinder problem solving. Creating a supportive classroom atmosphere where mistakes are seen as learning opportunities reduces fear. Incorporating mindfulness or stress-reduction techniques can also help.

Lack of Problem-Solving Experience

Students accustomed to routine exercises may struggle with open-ended problems. Gradually increasing complexity and scaffolding tasks builds confidence. Explicitly teaching problem-solving language and steps provides clarity.

Time Constraints

Problem solving often requires more time than procedural drills. Balancing curriculum demands with meaningful problem-solving practice is tricky. Integrating problem solving into daily lessons, rather than isolating it, ensures consistent exposure.

Building Lifelong Problem Solvers Through Mathematics

Ultimately, teaching problem solving in mathematics is about more than mastering content—it's about empowering students with skills that serve them throughout life. Problem solving nurtures curiosity, adaptability, and logical reasoning, qualities essential in an ever-changing world. By fostering these abilities, educators prepare learners not just to succeed in math, but to become confident thinkers and problem solvers in all areas. When we shift the focus from simply getting the right answer to understanding the process, we open doors for creativity, innovation, and critical thinking. This approach transforms math education into an inspiring journey where students discover their potential to tackle challenges, inside and outside the classroom.

Teaching problem solving in mathematics is no longer just an academic goal—it's a vital life skill every learner needs to navigate today's complex world. As we advance through 2026, education systems are pivoting toward nurturing deep cognitive abilities, shifting away from rote memorization toward authentic understanding. The core of this transformation lies in understanding and implementing effective strategies for teaching problem solving in mathematics.

Understanding the Importance of Problem Solving

Problem solving is the bridge between knowing mathematics and applying it meaningfully. Research from the National Council of Teachers of Mathematics (NCTM, 2024) shows that students who regularly engage in mathematical problem solving demonstrate stronger retention, critical thinking, and adaptability than those who focus solely on procedural practice. This shift reflects a broader global trend: PISA 2022 data indicates countries prioritizing problem-solving frameworks, like Finland and Singapore, consistently rank among the top in math proficiency.

Why does this matter so urgently? The workplace demands innovation, and future careers require analytical thinking. Teaching problem solving in mathematics equips students to tackle real-world challenges, breaking down problems, selecting appropriate strategies, and communicating solutions confidently.

Core Principles of Effective Problem Solving

To teach problem solving in mathematics successfully, educators must ground their approach in well-established pedagogical frameworks. Let's explore the essential components:

Introducing Cognitive Structures

Students benefit from understanding the underlying mental models—such as decomposition (breaking problems into parts), pattern recognition, and working backward—that structure mathematical reasoning. Research from Cognitive Science highlights that explicit instruction in these strategies increases problem-solving efficiency by 35% (Sweller & Ayres, 2025).

Balancing Structure and Exploration

While guided practice is necessary, allowing students to explore multiple solution paths fosters creativity. The "productive struggle" model, widely adopted in project-based learning, enables students to wrestle meaningfully before receiving intervention. Studies show this approach boosts engagement and reduces math anxiety (Wiggins & McTighe, 2023).

Creating a Supportive Learning Environment

A classroom that encourages risk-taking is the foundation of strong problem-solving skills. Students must feel safe making mistakes, as errors are data points illuminating gaps in understanding. Teachers can foster this by normalizing struggle and celebrating insightful attempts, not just correct answers.

Group collaboration enhances learning through diverse perspectives. A meta-analysis in *Educational Research Review* (2025) found that peer discussion during problem solving improves solution accuracy and mathematical reasoning by 28%. Structured protocols—like "think-pair-share" or jigsaw activities—can maximize these benefits.

Modeling Effective Thinking

Explicit modeling of a problem-solver's inner dialogue is critical. When teachers verbalize their thought process—asking, "What's the question? What information do I have? What might be a starting point?"—students learn to self-monitor and articulate their reasoning. This metacognitive transparency accelerates mastery.

Strategies and Tools to Enhance Problem

Modern pedagogy incorporates varied techniques to engage learners across stages. Let's examine proven methods:

Problem Types and Sequencing

Designing a curriculum around progressive problem difficulty ensures cognitive growth. The "Mathematical Problem Solving Progressions" (MPP) framework, developed by Boaler & Fennema (2023), recommends beginning with concrete representations (manipulatives), advancing to visual models (tables, graphs), and converging on abstract symbols. This spiral approach prevents frustration and builds confidence.

Real-World Integration

Contextualizing problems connects abstract math to students' lives. For example, a geometry lesson on area might involve redesigning a classroom layout, while algebra can tackle budgeting. Incorporating current, culturally relevant scenarios increases motivation and relevance—key to long-term engagement.

Technology as a Catalyst

Interactive platforms like Desmos, GeoGebra, and AI tutors now support personalized problem-solving practice. These tools provide instant feedback, track progress, and suggest next steps. UNESCO reports that AI-augmented learning improves problem-solving skill acquisition by 42% compared to traditional methods.

Addressing Common Challenges

Despite best efforts, barriers persist. One major hurdle is student discomfort with uncertainty. Frequent high-stakes testing can discourage risk-taking, pushing students toward memorized tricks rather than thoughtful reasoning. Reforming assessments to value process over perfection is essential.

Another issue is inequitable access to quality instruction. Teachers require targeted professional development in problem-solving pedagogy. A 2025 McKinsey report found schools with ongoing coaching saw problem-solving proficiency increase by 58%, compared to 22% in schools with isolated workshops.

Overcoming Student Resistance

Some learners disengage when problem solving feels abstract or daunting. Addressing this requires scaffolding: starting with guided questions, providing partial hints, and gradually releasing responsibility. Research in *Journal of Mathematical Behavior* (2024) confirms this scaffolding model reduces dropout rates in advanced problem-solving tasks.

Measuring Progress and Sustaining Growth

Traditional tests miss critical dimensions of problem-solving. To assess true growth, educators should use performance tasks, portfolios, and rubrics evaluating reasoning, creativity, and collaboration. The Common Core's emphasis on application metrics supports this shift.

Longitudinal studies show students taught with robust problem-solving strategies retain 50% more content over years (Hiebert & Carpenter, 2023). Tracking this retention over time is vital to proving the value of these methods.

The Future of Teaching Problem Solving

As we move into 2026, emerging trends are shaping best practices. AI tutors now generate personalized problem sets adapting in real-time to student needs. Virtual and augmented reality offer immersive problem-solving environments, enabling learners to explore 3D geometry or statistical simulations interactively.

Teacher collaboration is also evolving. Global networks and open educational resources (OER) allow educators to share effective problem-solving lessons and analytics. Platforms like Khan Academy and IXL now integrate peer review and AI feedback, expanding support beyond the classroom.

Policy initiatives increasingly prioritize problem-solving. The U.S. national math framework (2024) mandates explicit teaching of problem-solving across grade levels, signaling a movement toward systemic change.

Conclusion

Teaching problem solving in mathematics is foundational to developing resilient, innovative thinkers. It transcends subject mastery, fostering skills essential for lifelong learning. By embracing cognitive science, collaborative environments, and modern tools, educators create pathways where every student can thrive.

Ultimately, "teaching problem solving in mathematics" is about cultivating confidence—confidence in one's ability to reason, adapt, and solve. As learners progress through challenging problems, they discover not just math, but their own

potential. The journey demands intentionality, but the return is immense: a generation equipped to shape a complex world with clarity and creativity. The future of education depends on nurturing this goal.

Meta description: Teaching problem solving in mathematics empowers learners with critical thinking and real-world skills. This article outlines proven strategies, research-backed insights, and future trends to support educators in cultivating strong problem solvers.

Teaching Problem Solving in Mathematics: Strategies, Challenges, and Best Practices **Teaching problem solving in mathematics** remains a critical focus in contemporary education, reflecting a shift from rote memorization to fostering analytical thinking and adaptability. As curricula worldwide emphasize the development of higher-order cognitive skills, educators are tasked with equipping students not only to master mathematical procedures but also to navigate complex, unfamiliar problems effectively. This article delves into the methodologies, challenges, and pedagogical implications of teaching problem solving in mathematics, highlighting its importance in cultivating mathematical literacy and critical reasoning.

The Importance of Problem Solving in Mathematics Education

Mathematics is often perceived as a rigid discipline defined by formulas and procedures. However, problem solving introduces a dynamic element that requires learners to apply knowledge creatively. Teaching problem solving in mathematics extends beyond finding correct answers; it involves understanding problem contexts, devising strategies, reasoning logically, and reflecting on solutions. Research indicates that students who engage regularly in problem-solving tasks develop stronger conceptual understanding and are better prepared for real-world applications. According to the National Council of Teachers of Mathematics (NCTM), problem solving should be the “focus of school mathematics.” This orientation aligns with the increasing demand for STEM competencies in the workforce, where problem-solving aptitude is highly valued. Moreover, the Programme for International Student Assessment (PISA) assesses mathematics literacy through problem-solving scenarios, underscoring the global recognition of this skill.

Effective Strategies for Teaching Problem Solving in Mathematics

The process of teaching problem solving in mathematics requires deliberate planning and instructional strategies that promote active learning. Educators often face the challenge of balancing curriculum coverage with the time-intensive nature of problem-solving activities. Nevertheless, several approaches have demonstrated effectiveness:

1. Emphasizing Heuristic Methods

Heuristics such as drawing diagrams, working backward, and identifying patterns provide learners with versatile tools to approach unfamiliar problems. Teaching these strategies explicitly helps students develop a repertoire of techniques adaptable to various contexts.

2. Incorporating Real-World Problems

Contextualizing problems within real-life scenarios enhances engagement and relevance. Problems related to finance, engineering, or everyday decision-making encourage students to see mathematics as a practical tool rather than an abstract subject.

3. Promoting Collaborative Learning

Group problem solving cultivates communication skills and exposes students to diverse perspectives. Collaborative

settings enable peer instruction, where students articulate reasoning and challenge each other's thinking, deepening conceptual understanding.

4. Using Formative Assessment and Feedback

Ongoing assessment during problem-solving tasks allows teachers to identify misconceptions and provide timely feedback. This formative approach supports learner progress and helps tailor instruction to individual needs.

Challenges in Teaching Problem Solving in Mathematics

Despite its recognized value, teaching problem solving in mathematics is not without obstacles. One significant barrier is the traditional emphasis on procedural fluency in many educational systems, which may leave insufficient room for exploratory learning. Additionally, students often experience anxiety when confronted with open-ended problems, which can hinder their willingness to engage. Another challenge lies in teacher preparedness. Many educators report a lack of confidence or training in facilitating problem-solving instruction effectively. Without a deep understanding of problem-solving pedagogy, teachers may revert to didactic methods that limit student autonomy. Furthermore, assessment practices often focus on right or wrong answers rather than the reasoning process, discouraging risk-taking and creative approaches. To overcome these challenges, systemic changes in curriculum design, teacher professional development, and assessment frameworks are necessary.

Integrating Technology to Enhance Problem-Solving Skills

The integration of technology offers promising avenues for enhancing teaching problem solving in mathematics. Digital tools such as dynamic geometry software, interactive simulations, and online problem repositories provide students with immediate feedback and opportunities for exploration. For instance, platforms like GeoGebra enable learners to manipulate mathematical objects and visualize relationships, fostering deeper insight. Similarly, adaptive learning systems can adjust problem difficulty based on student performance, promoting personalized learning paths. However, reliance on technology also requires careful consideration. Educators must ensure that digital tools complement rather than replace critical thinking and that all students have equitable access to resources.

Key Components of a Problem-Solving Curriculum

Developing an effective curriculum that prioritizes problem solving involves integrating several essential components:

1. **Conceptual Understanding:** Establishing foundational knowledge that supports flexible thinking.
2. **Strategic Competence:** Teaching methods for approaching and solving diverse problems.
3. **Adaptive Reasoning:** Encouraging logical thinking and justification of solutions.
4. **Productive Disposition:** Building a positive attitude towards challenges and persistence.

Embedding these elements ensures that teaching problem solving in mathematics is holistic, addressing cognitive, metacognitive, and affective dimensions.

Measuring the Impact of Problem-Solving Instruction

Evaluating the effectiveness of teaching problem solving in mathematics can be complex. Traditional assessments may fail to capture the nuanced skills involved. Performance-based assessments, such as open-ended tasks, portfolios, and presentations, provide richer data on student competencies. Longitudinal studies have shown that students exposed to problem-solving instruction demonstrate improved critical thinking and transfer of knowledge across subjects. Moreover,

these students often exhibit increased motivation and confidence in mathematics.

Future Directions and Innovations

As educational paradigms evolve, teaching problem solving in mathematics is poised to benefit from interdisciplinary approaches and research-informed practices. Integrating cognitive science insights about learning processes can refine instructional methods, while advancements in artificial intelligence may offer new personalized learning experiences. Professional learning communities and collaborative networks also support teachers in sharing best practices and overcoming challenges associated with problem-solving pedagogy. Ultimately, fostering a culture that values inquiry, exploration, and resilience will shape the next generation of mathematical thinkers. In sum, teaching problem solving in mathematics is an essential endeavor that requires commitment, creativity, and continuous adaptation. By equipping students with problem-solving skills, educators are preparing them not only for academic success but for a future where analytical reasoning and innovation are paramount.

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Mastering the Art of Teaching Problem Solving in Mathematics teaching problem solving in mathematics transcends rote memorization—it demands cognitive agility, strategic thinking, and a learner-centered approach. As educational paradigms shift toward competency-based learning, the ability to dissect challenges, synthesize information, and derive solutions has become a cornerstone of effective mathematics instruction. This article investigates how educators can cultivate robust problem-solving skills, leveraging research-backed methodologies and addressing persistent obstacles.

H2: Understanding the Foundations of Problem-Solving in Math At its core, problem-solving in mathematics involves identifying relationships, applying procedures, and constructing logical pathways—often under time or resource constraints. Unlike memorizing algorithms, expert problem solvers engage in deep inquiry, questioning assumptions, and exploring multiple solution routes. A 2022 meta-analysis in *Mathematics Education Research Journal* found that students exposed to inquiry-based learning outperformed peers in standardized assessments by an average of 27%, underscoring the value of this approach. The framework includes stages: comprehension (understanding the problem), planning (devising strategies), execution (solving), and reflection (evaluating outcomes). Yet, many classrooms still emphasize formulaic practice over authentic challenge, leaving students ill-prepared for real-world complexity.

H2: Key Disparities in Current Pedagogical Approaches Data reveals a stark contrast between traditional and modern methods. Conventional instruction, reliant on worksheets and step-by-step guidance, trains students to follow protocols but stifles creativity. A 2021 study by the National Council of Teachers of Mathematics (NCTM) reported that only 38% of teachers regularly incorporate open-ended problems—those with multiple valid answers—into lessons. By comparison, schools using PISA-inspired enrichment curricula saw a 19% increase in problem-solving scores over three years.

Pros of problem-centered pedagogy: Fosters transferable skills across disciplines Encourages resilience when initial attempts fail Develops metacognition—thinking about one’s thinking Cons include: Greater time demands from teachers Initial frustration in non-traditional learning environments High stakes tied to standardized metrics that favor speed over depth

H2: Strategies to Cultivate Problem-Solving Competence To shift from passive learners to active problem solvers, educators employ several proven techniques.

H3: Scaffolding: Building Confidence Gradually Scaffolding tailors challenges to students’ readiness levels, introducing complexity incrementally. For example, starting with guided questions (“What properties define this shape?”) before independent solution drafting. Research indicates that well-structured scaffolding leads to a 41% improvement in self-efficacy, as measured by student confidence surveys.

H3: Promoting Collaborative Learning Group work diversifies perspectives: one student might recognize a pattern, another a logical fallacy. A 2023 study in *Journal of Educational Psychology* found that collaborative problem-solving teams solve 30% more varied problems than solo learners, due to distributed cognitive effort. However, mismanaged groups can amplify errors—highlighting the need for clear roles and facilitation.

H3: The Role of Feedback in Reflection Timely, specific feedback accelerates learning. Rather than correcting errors directly, effective teachers ask probing questions (“Why did that assumption change the path?”). This method, termed productive struggle, correlates with greater retention—students retain concepts 55% longer when guided through difficulties by educators.

H2: Integrating Real-World Contexts for Relevance Abstract problems often alienate students. Introducing scenarios grounded in everyday life—budgeting, architecture, or data analysis—anchors learning. For instance, optimizing a grocery budget uses ratio and proportion, directly linking to financial literacy.

Comparative Examples: Traditional math: Solve “ $x + 5 = 12$.” Problem-solving: “A grocery store needs to minimize waste while maximizing customer satisfaction; calculate optimal order quantities.” This approach not only improves engagement but also enhances long-term application. Surveys show 63% of employers prioritize problem-solving over calculation skills in early-career hires.

H2: Overcoming Systemic Challenges Despite evidence, barriers persist. Teacher training often lacks emphasis on inquiry methods, creating gaps in instructional confidence. A 2020 report noted only 29% of new math teachers felt prepared to lead problem-based lessons. Classroom time pressures compound the issue: bell schedules rarely allocate space for extended explorations. Yet, time management tools—such as flipped classrooms reducing lecture time—free up minutes for dynamic problem-solving activities.

H2: Leveraging Technology and Assessment Innovations Digital platforms now enable adaptive learning, offering personalized challenges based on student performance. Tools like Desmos and GeoGebra visualize abstract concepts, bridging gaps between intuition and formal proof. Assessment shifts are critical: moving from multiple-choice exams to performance tasks. The Programme for International Student Assessment (PISA) now weights problem-solving questions at 35%, rewarding depth.

Opportunities & Limitations: Pros: Immediate analytics inform instructional

adjustments Cons: Risk of over-reliance on tools, neglecting deep conceptual grasp ### Conclusion: A Path Forward teaching problem solving in mathematics demands a multifaceted strategy, blending pedagogy, collaboration, and technological integration. While challenges remain—particularly in teacher readiness and resource equity—the benefits are clear: students develop adaptable, lifelong skills. Key Takeaways: Prioritize inquiry over repetition Structure learning to balance scaffolding and autonomy Link math to authentic contexts Invest in professional development As educational systems evolve, the focus must remain on empowering learners to think, not just compute.

Future Implications

Emerging trends—such as AI-driven tutoring and interdisciplinary curricula—promise to amplify problem-solving reach. Yet, human mentorship will remain irreplaceable in guiding students through uncertainty. This holistic approach ensures that problem-solving becomes more than a skill—it becomes a mindset.

Final Analysis

The data is compelling: effective problem-solving instruction correlates with higher achievement, creativity, and equity. By confronting systemic hurdles and embracing evidence-based practices, educators can transform mathematics classrooms into incubators of intellectual growth. The journey is complex, but the payoff—a generation of resilient, analytical thinkers—is well worth the effort. (Word count: ~1,000+)

Questions & Answers About teaching problem solving in mathematics

No	Question	Answer
1	What are effective strategies for teaching problem solving in mathematics?	Effective strategies include encouraging a growth mindset, using real-world problems, teaching multiple problem-solving methods, promoting collaborative learning, and guiding students through the problem-solving process step-by-step.
2	How can teachers help students develop critical thinking skills through math problem solving?	Teachers can pose open-ended problems, encourage reasoning and justification of answers, use questioning techniques to deepen understanding, and create opportunities for students to explore different solutions to the same problem.
3	Why is it important to teach problem solving explicitly in mathematics?	Explicitly teaching problem solving helps students build confidence, develop analytical skills, and understand mathematical concepts more deeply. It prepares them to tackle unfamiliar problems and apply math in real-life situations.
4	What role do manipulatives and visual aids play in teaching math problem solving?	Manipulatives and visual aids help students visualize abstract concepts, making problems more concrete and understandable. They support diverse learning styles and can help students explore and discover problem-solving strategies.
5	How can technology be integrated to enhance teaching problem solving in mathematics?	Technology tools like interactive simulations, math software, and online problem-solving platforms provide dynamic and engaging ways to explore mathematical concepts, offer immediate feedback, and allow for differentiated instruction tailored to individual student needs.

mathematics problem solving, teaching strategies, critical thinking, math pedagogy, problem-based learning, cognitive skills, mathematical reasoning, collaborative learning, inquiry-based instruction, conceptual understanding

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