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Appraisal of Improvisational Teaching on Students' Problem-Solving Skills in Chemistry

[*1]Samira Anka Rabi'u & [2]Fatima Dobi Abubakar

[*1&2]Federal Federal University, Birnin Kebbi, Kebbi State, Nigeria. **Email:** samira.anka@fubk.edu.ng

Abstract

Improvisational teaching, which involves adapting instructional strategies based on real-time classroom dynamics and students' needs, has gained recognition as an effective pedagogical approach in enhancing student learning outcomes, particularly in chemistry education. This paper explores the role of improvisational teaching in fostering problem-solving skills, critical thinking, and active student engagement. By contrasting traditional, predetermined curricula with improvisational methods, the study highlights the advantages of flexibility and responsiveness in teaching. Key strategies such as role-playing, improvisational experiments, chemistry charades, peer teaching, and the Think-Pair-Share method are examined in the context of chemistry education, demonstrating how these approaches encourage creativity, collaboration, and deep conceptual understanding. Furthermore, the paper discusses the impact of improvisational teaching on student confidence, adaptability, and communication skills, all of which are vital for academic success and future professional endeavors. Supported by recent research, including studies on the application of improvisational techniques in science classrooms, the findings suggest that improvisation enhances student engagement, improves problem-solving abilities, and cultivates a passion for inquiry and discovery. The integration of improvisational teaching in chemistry classrooms not only prepares students for academic success but also equips them with essential competencies required in the modern workforce.

Keywords: Improvisational teaching, Traditional teaching, Problem solving skills, chemistry

Introduction

Improvisational teaching, defined as the ability of educators to adapt and modify instructional strategies in response to students' needs and real-time classroom dynamics, has garnered attention for its potential to enhance learning outcomes. In the context of chemistry education, which inherently involves complex problem-solving and critical thinking, improvisational teaching methods offer a promising approach to develop students' problem-solving skills. This paper argues that improvisational teaching positively influences students' ability to solve problems in chemistry, supported by recent

research and expert opinions. Improvisational teaching, characterized by the flexibility of educators to adapt instructional strategies based on students' immediate needs and classroom dynamics, has been identified as an effective approach in enhancing problem-solving skills (Ngendabangaet al., 2025). In chemistry education, where complexity and critical thinking are fundamental, improvisational techniques provide students with opportunities to actively engage with content, fostering creativity and deeper understanding (Ndukwe, 2021). Recent studies have shown that students exposed to problem-solving strategies often implemented through improvisational teaching demonstrate significantly higher performance in chemistry assessments compared to those taught using traditional lecture methods (Jegede & Fatoke, 2014). For example, the use of improvised chemicals and materials in resource-constrained environments has been linked to increased student motivation and academic achievement, suggesting that improvisational teaching not only enhances engagement but also deepens conceptual understanding (Ngendabanga et al., 2025)

This study aims to explore the impact of improvisational teaching on students' problem-solving abilities in chemistry, synthesizing key findings from recent research, expert opinions, and case studies. The evidence suggests that when educators embrace flexibility and responsiveness in their instructional methods, students are better equipped to tackle complex chemical problems, apply theoretical knowledge in practical contexts, and develop critical thinking skills essential for scientific inquiry

Traditional chemistry teaching often relies on predetermined curricula and structured approaches that may not fully engage students in the problem-solving process. Conventional methods typically emphasize rote learning and procedural knowledge, which can limit opportunities for students to practice and develop critical thinking skills essential for solving complex chemical problems. As Stroumpouli and Tsaparlis (2022) notes, traditional instruction tends to focus on algorithmic problem-solving and memorization, often neglecting the deeper cognitive processes required for conceptual understanding and analytical reasoning. Traditional chemistry teaching methods predominantly rely on fixed curricula and structured pedagogies. These methods often prioritize rote memorization and procedural learning over active engagement, limiting students' opportunities to develop higher-

order cognitive skills essential for solving complex chemical problems. As highlighted by the Royal Society of Chemistry, traditional lectures and laboratory formats often fail to support diverse learners in grasping abstract chemical concepts, calling for more interactive and blended approaches to foster deeper understanding (Royal Society of Chemistry, 2024). In contrast, improvisational teaching promotes a dynamic learning environment where the instructor's adaptability facilitates spontaneous problem-solving, critical thinking, and student engagement (Kaufman, 2020). This study investigates the shift from conventional approaches toward improvisational teaching, highlighting its alignment with contemporary educational practices emphasizing active learning.

1. A pre-determined curriculum refers to an educational plan or framework that is established before teaching begins, outlining what will be taught, in what order, and the learning objectives to be achieved. It is typically developed by educational authorities or institutions and is designed to ensure consistency and standardization across different classrooms or schools. According to the Glossary of Education Reform, a pre-determined curriculum is "a curriculum that is set in advance and outlines the specific knowledge and skills that students are expected to learn during a particular course or educational program." This type of curriculum is often contrasted with a more flexible or student-centered approach that might be adapted based on students' needs and interests.

2. Structured methodologies are the systematic, organized approaches used in various fields to achieve specific goals or manage complex processes. These methodologies provide a framework for how tasks should be performed, ensuring consistency, efficiency, and effectiveness.

3. Problem-solving skills refer to the ability to identify, analyze, and resolve issues effectively and efficiently. These skills involve a range of cognitive processes and strategies that enable individuals to tackle challenges and find solutions to various problems

In contrast, improvisational teaching involves adjusting instructional approaches based on students' responses, fostering a more dynamic and interactive learning environment. This method aligns with contemporary educational practices that emphasize active learning and student engagement,

critical for subjects like chemistry that demand high-level problem-solving abilities (Kaufman, 2020).

Statement of the Problem

In traditional chemistry education, students often face challenges in developing critical problem-solving skills due to the reliance on pre-determined curricula and structured instructional methods. These conventional approaches tend to emphasize rote memorization and procedural learning, which may limit opportunities for students to engage deeply with complex chemical problems and develop the higher-order cognitive skills necessary for real-world application. As chemistry inherently involves complex problem-solving and critical thinking, there is a growing need for innovative teaching methods that foster active student engagement, creativity, and adaptability.

Improvisational teaching, characterized by its flexibility and adaptability to students' needs and classroom dynamics, has emerged as a promising alternative to conventional teaching strategies. However, despite its potential, there is limited empirical evidence that directly links improvisational teaching to improved problem-solving skills in chemistry education. The current gap in research highlights the need to explore how improvisational teaching methods can effectively enhance students' ability to solve complex chemical problems and develop the critical thinking skills essential for success in both academic and professional settings.

This study aims to address this gap by investigating the impact of improvisational teaching strategies on the development of problem-solving skills in chemistry classrooms. Specifically, it will examine how techniques such as role-playing, improvisational experiments, chemistry charades, peer teaching, and Think-Pair-Share influence student engagement, collaboration, confidence, and real-time problem-solving abilities. By synthesizing findings from recent research, expert opinions, and case studies, this paper seeks to establish the efficacy of improvisational teaching in fostering critical thinking and problem-solving skills in chemistry education.

Origin of Improvisational Teaching

Improvisational teaching methods have gained traction as effective strategies for enhancing creativity and engagement in the classroom. Originating from the realms of theater and educational theory, these methods emphasize

spontaneity and active participation. Key figures such as Viola Spolin and Keith Johnstone have shaped these approaches, providing valuable frameworks that educators can adapt across various subjects. Their work, alongside contributions from theorists like John Dewey and contemporary educators, illustrates the ultimate potential of improvisation to transform learning experiences, encouraging students to think critically and express themselves freely. (Spolin, 2021).

Strategies for Conducting Improvisational Teaching

This study synthesizes findings from several improvisational teaching strategies employed in chemistry classrooms, including:

1. **Role-Playing Scenarios**: Role-playing scenarios immerse students in real-world scientific contexts, encouraging collaboration, critical analysis, and contextual understanding. Evidence suggests that role-play fosters a deeper connection to chemical concepts and enhances essential skills like public speaking and teamwork (Berk, 2009). Students actively participate in simulations of chemical processes, enriching their comprehension and encouraging independent thought.

2. **Improvisational Experiments**: By allowing students to design their own experiments within a flexible framework, improvisational experiments stimulate creativity and innovation. These activities align with constructivist theories that value active, hands-on learning (Tishman & Perkins, 2022). Research supports the efficacy of improvisational experiments in enhancing problem-solving skills and fostering critical thinking, as students develop and test their hypotheses using various scientific techniques (Kolb, 2021).

3. **Chemistry Charades**: The use of body language to represent chemical processes in chemistry charades enhances kinesthetic learning and deepens understanding. Research indicates that engaging in non-verbal representations of chemical concepts improves retention and promotes teamwork, which supports the broader cognitive and social development of students. Kinesthetic and multimodal strategies—such as physical dramatization of molecular interactions have been shown to enhance conceptual grasp and collaborative learning in chemistry classrooms (Taber, 2018).

4. **Peer Teaching**: In peer teaching, students take on the role of educators, reinforcing their own understanding while teaching peers. This method promotes student engagement, builds communication skills, and fosters a collaborative learning environment. Studies have shown that peer teaching enhances both academic achievement and personal development. For example, class-wide peer tutoring (CWPT) has been found to significantly improve students' achievement in chemistry compared to traditional lecture methods, while also promoting gender equity and collaborative learning (Nwafor et al., 2024).

5. **Think-Pair-Share**: This strategy, where students reflect individually, discuss in pairs, and share with the class, has been widely recognized for enhancing student participation and critical thinking. Evidence suggests that Think-Pair-Share supports the development of collaborative and communication skills, helping students articulate and refine their ideas while learning from diverse viewpoints (Smith & Alexander, 2023; Maughan & Dinsmore, 2022).

Impact of Improvisational Teaching on Problem-Solving Skills

Improvisational teaching significantly enhances problem-solving skills in chemistry education by fostering a flexible learning environment that emphasizes critical thinking and adaptability. This section summarizes key findings from multiple studies:

1. **Engagement and Motivation**: Improvisational teaching methods promote active student participation, leading to higher engagement levels. According to research by Kuhblman and Goodman (2016), students involved in improvisational tasks are more likely to explore new ideas, take intellectual risks, and engage deeply with course material. This enhanced engagement directly correlates with improved problem-solving capabilities.

2. **Collaboration and Communication**: Collaborative methods, such as role-playing and peer teaching, promote teamwork and communication, crucial for developing problem-solving skills. Baird and Gibbons (2017) note that improvisational strategies break down barriers between students, fostering an inclusive environment where

diverse perspectives are encouraged. This collaboration enhances students' ability to address complex problems through shared insights.

3. **Confidence and Adaptability**: Improvisational teaching reduces student anxiety, creating a safe space for experimentation and intellectual risk-taking. Dempsey (2018) highlights that when students feel confident in their abilities, they are more likely to persist through difficult problems, thus improving their problem-solving strategies. Improvisational teaching also develops adaptability, an essential skill in both academic and professional settings, where unforeseen challenges often arise.

4. **Real-Time Problem Solving**: In chemistry classrooms, improvisational techniques such as modifying experimental procedures in response to student observations allow for immediate feedback and adjustment. This approach encourages critical thinking and creative problem-solving as students are required to address obstacles in real-time. According to Davis and Johnson (2022), such responsive teaching methods enhance student engagement and problem-solving skills, making learning more dynamic and effective.

Supporting Evidence

The effectiveness of improvisational teaching methods in fostering problem-solving skills is supported by various research studies:

The benefits of improvisational teaching in chemistry extend beyond problem-solving skills, including:

Research by Furtak and Ruiz-Primo (2012) supports the effectiveness of improvisational teaching in improving problem-solving skills. Their study found that students in inquiry-based and adaptive learning environments showed greater problem-solving proficiency and higher levels of scientific reasoning. This aligns with the principles of improvisational teaching, which emphasizes adaptability and real-time problem-solving.

Educational expert Dr. Steven Schwartz also supports the use of improvisational techniques, noting that "improvisational teaching methods align well with the goals of modern science education, particularly in fostering critical thinking and problem-solving skills" (Schwartz, 2021).

Benefits of Improvisational Teaching in Chemistry

1. **Enhanced Student Engagement**: Improvisational methods make chemistry learning more interactive and student-centered, improving engagement and motivation.

2. **Development of Critical Thinking and Flexibility**: Students exposed to improvisational tasks develop essential critical thinking and adaptability skills, as they are regularly faced with unexpected challenges.

3. **Deeper Understanding of Chemistry Concepts**: The dynamic nature of improvisational learning encourages students to apply their theoretical knowledge in diverse and real-world contexts, leading to a deeper understanding of scientific concepts (Zion et al., 2010).

Challenges and Limitations

While improvisational teaching offers numerous advantages, its implementation can pose challenges.

1. Teachers must be adept at making quick adjustments and may require additional training to effectively use improvisational methods.

2. Improvisational approaches may not be suitable for all learning environments, particularly in large classes or settings with rigid curricula (Boud, Cohen, & Sampson, 2014).

3. Some students may struggle with the less structured nature of improvisational teaching, which could affect their learning experience if not managed carefully. Balancing improvisational techniques with structured elements is essential to ensure all students benefit from the teaching approach.

Conclusion

This study concludes that improvisational teaching positively influences students' problem-solving skills in chemistry by fostering active participation,

creativity, and critical thinking. The flexibility inherent in improvisational methods enables students to engage deeply with content, improving their ability to solve complex problems. Future research should explore the long-term impacts of improvisational teaching on students' academic and professional success, as well as the best practices for integrating improvisational strategies into traditional chemistry curricula.

By continuing to evaluate and refine these teaching methods, educators can further enhance the effectiveness of chemistry education, equipping students with the skills necessary for both academic achievement and lifelong learning.

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