Challenges in Science Education: The Impact of Limited Teacher Training on Hands-on Learning

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ABSTRACT

Hands-on learning is essential for effective science education, enabling students to engage directly with concepts through experimentation, observation, and inquiry. However, many basic education classrooms prioritize lecture-based instruction, hindering deeper understanding and critical thinking due to teachers' limited preparation in facilitating experiential activities. This qualitative descriptive study examines the impact of inadequate teacher training on implementing hands-on science lessons among science teachers at Halapitan National High School. Data were gathered via semi-structured interviews with these teachers, classroom observations, and reviews of lesson plans and training records. Findings indicate that undertrained teachers exhibit low confidence in conducting experiments, struggle with classroom management, and face challenges adapting to resource limitations, resulting in infrequent use of hands-on strategies and underdeveloped inquiry-based learning. Resource constraints exacerbate these issues, diminishing lesson quality and frequency. The study underscores the urgency of enhancing pre-service and in-service training with practical, skills-based components to boost teacher competence, foster student curiosity, engagement, and scientific literacy.

Keywords: Hands-on learning, Science education, Experimentation, Inquiry-based learning, Lecture-based instruction, Teacher training, Teacher preparation, Practical skills, Experiential activities

INTRODUCTION

Science education plays an important role in helping students think critically, solve problems, and understand the scientific ideas that explain the world around them. A key part of this learning process is hands-on instruction, which allows students to take part in experiments, investigations, and other practical activities that make scientific concepts easier to understand. Through these interactive methods, students develop stronger inquiry skills, learn how to observe carefully, and build their ability to analyze information. Recent studies show that hands-on activities also help students remember information better and stay more motivated in science classes (Laid & Adlaon, 2025; Posion, 2025). However, even with these proven benefits, many science classrooms still depend mostly on lecture-based teaching, which limits student engagement and reduces opportunities for meaningful, applied learning. A major reason for this problem is the limited training many teachers receive in guiding practical science lessons. Research shows that many teacher preparation programs focus more on theory than on real-world application, giving future teachers few chances to practice laboratory work or inquiry-based methods (Baniqued & Bautista, 2024). As a result, teachers may feel unprepared to manage experiments, use equipment safely, or design lessons that include hands-on materials. This challenge becomes even greater in schools with limited resources, where access to laboratory supplies and ongoing professional development is often restricted. Studies also note that teachers working outside their main subject area face greater difficulties with hands-on science instruction because they may lack confidence and content knowledge (Edulan & Fajardo, 2024). Furthermore, institutional factors such as large class sizes and limited support make practical activities harder to implement (National Academies of Sciences, Engineering, and Medicine, 2025). This study aims to examine challenges in Science Education, the Impact of limited teacher training on hands-on Learning.

METHODS

This study employed a qualitative descriptive research design to investigate how limited teacher training affects the implementation of hands-on learning in science education. The study was implemented at Halapitan National

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High School, District 1 in the Division of Bukidnon, the largest public secondary school in the area. Six Junior High School science teachers, each with more than ten years of teaching experience, were selected to participate. The interviews were done in a relaxed, conversational manner, allowing teachers to share their thoughts freely while the researcher guided the discussion. Their answers were written down using a paper-and-pen questionnaire to keep the information accurate. Ethical procedures were strictly observed throughout the study. Permission was obtained from the Science and Technology department head and the school principal. The teachers were informed about the study's purpose and assured that their identities would remain confidential. They signed consent forms and were free to withdraw at any time. The data collected from the interviews were analyzed using thematic analysis, focusing on participants' personal perspectives and classroom contexts.

RESULTS AND DISCUSSION

The findings of the study clearly show that limited teacher training greatly affects how hands-on science learning is carried out in the classroom. Hands-on learning is important because it helps students explore, ask questions, and understand scientific ideas more deeply. When teachers are not trained well in practical science activities, they often feel nervous, unsure, or overwhelmed when they need to prepare lessons that involve experiments, materials, or open-ended tasks that require students to investigate on their own. Recent studies confirm that when teachers lack confidence and experience, they avoid practical lessons and choose safer, more predictable methods such as lectures and textbook-based teaching (Laid & Adlaon, 2025; Posion, 2025). Although lectures can help deliver information quickly, they do not give students the chance to experience science in action. Without this hands-on experience, students miss opportunities to develop scientific reasoning, creativity, and problem-solving skills. The gap between theory and practice grows wider, and students struggle to understand how scientific ideas apply to real situations.

The problem becomes even more serious when teachers do not receive continuous professional development. Research shows that teacher preparation programs often focus more on theory than on laboratory practice, leaving new teachers unprepared to guide experiments or manage a classroom during hands-on activities (Baniqued & Bautista, 2024). In-service teachers face similar challenges because many professional development programs are short or not aligned with real classroom needs (National Academies of Sciences, Engineering, and Medicine, 2025). As a result, teachers may not know how to create simple, low-cost experiments or use everyday materials to teach scientific concepts. When teachers lack these skills, they struggle to implement hands-on learning even when they want to.

Limited teacher training is a major barrier to effective hands-on science learning. Teachers who lack practical, inquiry-based preparation often feel less confident in conducting experiments and guiding student investigations. As a result, they rely heavily on lecture-based instruction, which limits student engagement and opportunities for critical thinking (Baniqued & Bautista, 2024. Additionally, ongoing professional development is crucial for in-service teachers, especially when it is sustained, collaborative, and includes coaching or mentoring (Darling-Hammond et al., 2023). Schools should also provide system-level support, including resources, lab equipment, and professional learning communities, to help teachers implement hands-on lessons effectively (Science Education International, 2025). Investing in teacher training and support ensures that students receive inquiry-rich, engaging science education.

CONCLUSION AND RECOMMENDATION

The findings of this study clearly show that limited teacher training remains a major obstacle to effective hands-on science learning. Teachers who have not received enough preparation in practical, inquiry-based methods are less confident and less likely to implement engaging instructional strategies that involve experiments and real scientific investigation. Research on science teacher preparation reveals that many future teacher's complete programs that focus more on theory than on practical classroom experience, leaving them without essential skills to design and lead hands-on activities (Baniqued & Bautista, 2024). Without these skills, teachers often rely on traditional lecture-based methods, reducing opportunities for students to explore scientific ideas through active participation, which is a key part of promoting scientific literacy and deeper understanding (Teachers Institute, 2023).

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This conclusion aligns with evidence that students benefit more when teachers are equipped to facilitate experiential and inquiry-based learning. Experiential learning helps students connect theory and practice, enhancing problem-solving and critical thinking skills that are otherwise difficult to achieve through lecture alone (Teachers Institute, 2023). When teachers lack confidence or training, classrooms tend to emphasize rote memorization and passive listening, which limits student engagement and weakens science learning outcomes.

The study's results also highlight that ongoing professional development (PD) is essential but frequently insufficient. Short, fragmented PD sessions do not provide the depth of support teachers need to sustain inquiry-based teaching over time. A recent meta-analysis of PD programs found that sustained PD significantly improves teachers' self-efficacy and ability to use effective science teaching strategies (Darling-Hammond et al., 2023). When teachers participate in long-term, reflective PD that includes coaching and opportunities to practice instructional techniques, they are more likely to adopt and maintain hands-on approaches in their classrooms.

Furthermore, the broader school environment and system support play an important role. Teachers in under-resourced schools face additional challenges such as lack of materials, equipment, and planning time, which makes it harder to implement practical activities even when teachers are motivated. Research on science education emphasizes that access to resources and supportive leadership encourages teachers to try innovative methods, whereas resource shortages reinforce instructional limitations (Baniqued & Bautista, 2024).

Overall, the literature supports the conclusion that strengthening both preservice preparation and continuous, high-quality professional development, backed by system-wide investment and support, is necessary to improve hands-on science learning. When teachers are well prepared and supported, they are more confident and capable of providing science lessons that engage students actively, build inquiry skills, and foster scientific literacy.

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