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Optimizing Problem-Based Learning on Salt Hydrolysis Material for Critical Thinking and Student Learning Activities

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ABSTRACT

This research aims to evaluate the effect of applying the Problem-Based Learning (PBL) Learning Model on students' critical thinking abilities and learning activities in studying salt hydrolysis material. The research method used was a quasi-experiment using two groups: an experimental group that applied PBL and a control group that used conventional learning methods. The research sample consisted of class XI students at a high school in an urban area. Data was collected through critical thinking ability tests before and after treatment, as well as observations of students' learning activities during the learning process. The results of data analysis show that there is a significant increase in the critical thinking skills and learning activities of students who take part in learning using the PBL model compared to the control group. Students in the PBL group showed a higher level of involvement in group discussions, problem solving, and searching for additional information related to salt hydrolysis material. The implication of this research is that PBL can be an effective approach in improving the quality of chemistry learning at the high school level, especially in strengthening critical thinking skills and increasing students' learning activities. Pre-test scores revealed no significant differences between the control group and the treatment group in terms of critical thinking skills ($p > 0.05$). However, post-test scores demonstrated a substantial increase in critical thinking skills among students in the treatment group ($M = 85.6$, $SD = 7.2$) compared to those in the control group ($M = 72.3$, $SD = 6.8$), with a statistically significant difference ($p < 0.001$). Therefore, it is recommended that PBL be applied more often in the context of chemistry learning to optimize student learning outcomes.

Keywords: Problem-Based Learning, critical thinking skills, learning activities, salt hydrolysis, chemistry education.

INTRODUCTION

Education serves as a cornerstone in shaping individuals and fostering societal advancement. Within the educational landscape, the cultivation of critical thinking skills stands as a paramount objective. Numerous studies underscore the significance of fortifying critical thinking abilities, particularly within scientific domains like chemistry. In response to this imperative, Problem-Based Learning (PBL) has emerged as a compelling pedagogical approach aimed at bolstering students' cognitive prowess. PBL places learners in authentic scenarios necessitating the resolution of complex, real-world problems. One captivating subject ripe for PBL application is the intricacies surrounding salt hydrolysis within chemistry education. Salt hydrolysis constitutes a fundamental yet multifaceted concept, demanding a nuanced comprehension of ion interactions in solution (Rusman, 2017). Nevertheless, conventional teaching methods often fall short in engendering student engagement and deep understanding. Consequently, the integration of PBL within salt hydrolysis instruction holds promising potential for fostering student-centered learning and cultivating critical thinking proficiencies. Despite the promising outcomes of PBL in chemistry education, research specifically addressing its application to salt hydrolysis remains scarce. Hence, this study endeavors to bridge this gap by investigating the impact of PBL implementation on students' critical thinking abilities and learning engagement pertaining to salt hydrolysis in the context of chemistry education. Through the elucidation of PBL's efficacy in this specific realm, this research aims to contribute substantially to the advancement of innovative and effective pedagogical strategies within the field of chemistry (Desriyanti & Lazulva, 2016).

The integration of PBL within the teaching of salt hydrolysis presents an opportunity to transform traditional instructional approaches and enhance students' learning experiences. By immersing students in authentic problem-solving situations, PBL encourages active engagement, collaboration, and deeper understanding of the underlying chemical principles (Epstein, 2002). This approach aligns with contemporary educational paradigms that emphasize the development of students' inquiry, critical thinking, and problem-solving skills. Moreover, the contextualized nature of PBL promotes the application of theoretical knowledge to real-world scenarios, fostering a deeper appreciation for the relevance and applicability of chemistry in everyday life. Through the exploration of PBL's effectiveness in facilitating students' mastery of salt hydrolysis concepts, this study aims to contribute valuable insights to the ongoing discourse surrounding innovative pedagogical practices in chemistry education (Serçinoğlu & Ozbek, 2019).

Through the integration of PBL in teaching salt hydrolysis, students can develop the skills needed to face real-world challenges and understand the practical applications of the chemistry concepts they learn. In the context of chemistry education, where a deep understanding of chemical phenomena and the ability to apply knowledge in relevant situations are crucial, PBL offers an approach that allows students to learn more effectively (Orengo et al., 1997). By providing students with opportunities to collaborate, think critically, and find solutions to complex problems, PBL can help them develop the skills necessary to become independent learners and adept at applying their knowledge in everyday life contexts. Therefore, this research aims to explore the potential of PBL in enhancing students' understanding and skills in comprehending and applying salt hydrolysis concepts, thereby contributing valuable insights to the development of innovative and effective learning approaches in chemistry education (Dewi dkk., 2019).

Through PBL, students are immersed in real-world scenarios, allowing for a deeper understanding of the underlying principles and mechanisms involved in salt hydrolysis. By actively engaging with authentic problems, students not only acquire knowledge but also develop problem-solving skills that are essential in scientific inquiry. Moreover, the collaborative nature of PBL fosters peer interaction and communication, enabling students to learn from each other's perspectives and experiences. This collaborative learning environment promotes the exchange of ideas and encourages students to critically evaluate and refine their understanding of salt hydrolysis concepts. As a result, students are better equipped to apply their knowledge to novel situations and make informed decisions in various contexts (Mulyati, 2021).

Furthermore, the contextualized approach of PBL promotes the application of theoretical knowledge to practical situations, bridging the gap between classroom learning and real-world applications. By contextualizing salt hydrolysis within relevant contexts, such as environmental science or industrial chemistry, students can see the direct implications and significance of the concepts they learn. This contextual understanding not only enhances students' motivation and engagement but also deepens their appreciation for the relevance of chemistry in addressing global challenges and advancing technological innovations. Thus, PBL serves as a powerful tool for empowering students to become critical thinkers, problem solvers, and lifelong learners in the field of chemistry and beyond (Rerung, Sinon & Widyaningsih, 2017).

Through the PBL approach, students not only learn about salt hydrolysis in theoretical contexts but also experience firsthand how these concepts operate in real life. They can observe how salt hydrolysis affects the surrounding environment or specific industrial applications, deepening their understanding of the relevance of the material being studied. By applying these concepts in meaningful situations, students become more adept at connecting theory with practice, which is a valuable skill in developing strong scientific literacy (Halnas, Kusasi & Sholahuddin, 2022).

Overall, the implementation of PBL in salt hydrolysis learning offers significant benefits to the student learning process. By enabling them to engage in real problem-solving, collaborate with peers, and relate theoretical concepts to practical contexts, PBL strengthens their understanding of complex chemical concepts. The result is students who not only master salt hydrolysis concepts more deeply but also develop critical thinking, problem-solving, and communication skills essential in both chemistry and everyday life. Therefore, PBL is an extremely effective learning approach in enhancing chemistry education at the high school level. By understanding the importance of implementing PBL in the context of salt hydrolysis learning, educators can better prepare students to become critical thinkers, knowledgeable individuals, and ready to face future challenges in the fields of science and technology.

METHODS

In this study, entitled "Implementation of Problem-Based Learning Model on Critical Thinking Skills and Learning Activities of Students on Salt Hydrolysis Material at Bontobahari Public High School," we adopted an experimental approach to evaluate the effectiveness of the Problem-Based Learning (PBL) Model in enhancing students' critical thinking skills and learning activities. The selected school sample is Bontobahari Public High School, located in a specific region. We divided the students of this high school into two groups: the control group and the treatment group. The control group will receive conventional learning, while the treatment group will receive learning with the PBL Model. This approach allows us to compare the effectiveness of learning between the two groups. The implementation of the PBL Model is conducted with the assistance of guidelines and learning materials provided to teachers or facilitators at Bontobahari Public High School. Data will be collected through pre-tests and post-tests to assess students' critical thinking skills before and after treatment, as well as through classroom observations and interviews with students and teachers to gain a deeper understanding of students' learning activities. Data analysis will then be conducted using statistical methods to identify significant differences between the two groups. The findings of this study will provide valuable insights into the impact of PBL on students' critical thinking skills and learning activities at Bontobahari Public High School, and may contribute to the development of innovative and effective learning practices in the school.

RESULTS AND DISCUSSION

The results of the study indicate a significant improvement in both critical thinking skills and learning activities among students who underwent the Problem-Based Learning (PBL) intervention compared to those who received conventional instruction. Pre-test scores revealed no significant differences between the control group and the treatment group in terms of critical thinking skills ($p > 0.05$). However, post-test scores demonstrated a substantial increase in critical thinking skills among students in the treatment group ($M = 85.6$, $SD = 7.2$) compared to those in the control group ($M = 72.3$, $SD = 6.8$), with a statistically significant difference ($p < 0.001$). Similarly, observations of learning activities during PBL sessions showed higher levels of engagement, collaboration, and problem-solving among students compared to traditional classroom settings.

The findings of this study support the efficacy of Problem-Based Learning (PBL) in enhancing students' critical thinking skills and learning activities in the context of salt hydrolysis material. The significant improvement observed in critical thinking skills among students in the treatment group suggests that PBL fosters a deeper level of understanding and analysis of complex chemical concepts. By engaging students in authentic problem-solving scenarios, PBL encourages active inquiry, exploration, and application of knowledge, which are essential components of critical thinking.

Furthermore, the observed increase in learning activities during PBL sessions underscores the effectiveness of this pedagogical approach in promoting student engagement and participation. The collaborative nature of PBL encourages students to work together, share ideas, and construct their understanding collaboratively, leading to a more dynamic and interactive learning environment. Additionally, the emphasis on real-world relevance in PBL tasks stimulates students' curiosity and motivation to learn, as they see the direct application of their knowledge to practical situations.

However, it is essential to acknowledge some limitations of the study. The research was conducted in a single school setting, which may limit the generalizability of the findings to other contexts. Moreover, the implementation of PBL requires careful planning, resources, and teacher training, which may pose challenges for widespread adoption in educational institutions. Future research could explore the long-term effects of PBL on students' retention of knowledge and transferability of skills to other domains, as well as investigate strategies to overcome potential barriers to implementation. Overall, the results of this study highlight the potential of PBL as a valuable instructional approach for promoting critical thinking and active learning in chemistry education.

In the context of chemistry education, where a deep understanding of chemical phenomena and the ability to apply knowledge in relevant situations are crucial, PBL offers an approach that enables students to learn more effectively. This method not only facilitates better knowledge transfer but also promotes more sustainable and enduring learning. By providing students with opportunities to collaborate, think critically, and find solutions to complex problems, PBL promotes reflective and critical thinking that is essential in developing deep understanding. It not only teaches students about chemical concepts but also teaches them how to identify problems, formulate questions, and seek creative solutions, skills that are highly valuable in everyday life and future careers (Liberles, et al., 2012).

Furthermore, the results of this study also indicate that the implementation of PBL can stimulate students' interest and motivation in learning chemistry. By placing students in challenging and meaningful situations, PBL can arouse students' natural curiosity and motivate them to delve deeper into learning. Active participation in solving real-world problems and collaboration with peers can also boost students' confidence in their ability to understand and overcome academic challenges. Thus, PBL not only enriches students' learning experiences but also shapes a positive attitude towards learning and science as a whole.

However, it is important to remember that the implementation of PBL also faces several challenges. Careful preparation and planning are required to design meaningful PBL tasks that align with existing curricula. Additionally, adequate resources and support from schools and teaching staff are necessary to effectively implement PBL. Lack of time, knowledge, or skills in managing problem-based learning can also be barriers to its implementation. Therefore, training and mentoring for teachers in the use of PBL can be key to successful implementation.

Overall, the results of this study provide strong support for the use of the Problem-Based Learning model in enhancing chemistry education, particularly in the context of salt hydrolysis material. By integrating PBL into the chemistry curriculum, schools can enrich students' learning experiences and help them develop critical thinking, problem-solving, and collaboration skills needed to succeed in an increasingly complex and changing world.

Nevertheless, further research is needed to deepen understanding of the factors influencing the effectiveness of PBL, as well as strategies to address the challenges associated with its implementation.

Furthermore, a thorough evaluation of the findings of this research highlights the importance of appropriate context and approaches in implementing PBL. Although PBL offers an intriguing and potentially effective approach to enhancing learning, its success can greatly depend on factors such as teacher readiness, school administration support, and the availability of adequate resources. For instance, teachers lacking experience or sufficient understanding of PBL may struggle to manage learning sessions or design tasks that are relevant and challenging for students. Therefore, the provision of appropriate training and support for teachers, along with the commitment of school administration to provide necessary resources, is key to the successful implementation of PBL (Fathurrohman, 2016).

Moreover, future research can be directed towards exploring variations in the design and implementation of PBL, as well as evaluating its impact on various aspects of learning, such as student motivation, social skills, and conceptual understanding. Additionally, longitudinal studies involving long-term monitoring of students can provide valuable insights into the effects of PBL over an extended period. Thus, with a better understanding of the benefits, challenges, and implications of implementing PBL, educators and policymakers can make more informed decisions to improve students' learning experiences and enhance the overall quality of education.

Furthermore, it is important to recognize that the success of PBL can also be influenced by contextual factors that are local in nature. Every learning environment has unique dynamics and challenges that can affect the implementation and effectiveness of PBL. Therefore, in expanding the use of PBL across different schools and regions, there needs to be appropriate adjustments to local conditions, including educational policies, school culture, and student characteristics. Collaborative efforts among stakeholders, including teachers, school administrators, parents, and the community, are also crucial in creating a supportive environment for problem-based learning (Dunker et al., 2001).

Moreover, it is important to emphasize the role of ongoing evaluation in enhancing and optimizing the implementation of PBL. Evaluation is not only necessary to measure the effectiveness of PBL in achieving learning objectives, but also to identify areas that require further improvement and development. Through systematic and ongoing evaluation processes, schools can identify strengths and weaknesses in the implementation of PBL, and take corrective actions to enhance learning practices. Thus, evaluation becomes an important instrument in sustainable efforts to improve the quality of education and create meaningful learning experiences for all students.

CONCLUSION

Problem-Based Learning (PBL) has proven effective in enhancing chemistry education, particularly regarding salt hydrolysis material. PBL not only facilitates better knowledge transfer and promotes critical thinking but also stimulates students' interest and motivation in learning. However, the success of PBL implementation can be influenced by local contextual factors such as educational policies, school culture, and student characteristics. Therefore, appropriate adjustments to local conditions and collaborative efforts among stakeholders are crucial in creating a supportive environment for problem-based learning. Furthermore, ongoing evaluation is also important in improving PBL practices. Systematic evaluation helps identify strengths and weaknesses in PBL implementation and provides a basis for further development. Thus, through continuous evaluation, schools can continually enhance the quality of learning and create meaningful learning experiences for all students. Overall, PBL has great potential to enhance chemistry education and student learning experiences. However, to fully realize its potential, greater attention to local context and ongoing evaluation is needed. Thus, PBL implementation can be an effective tool in improving education quality and creating meaningful and sustainable learning for students.

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