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Strategy for Utilizing Online Discussions and Online Practices on SPADA LMS to Improve Physics Learning in the Digital Era

Juniarti Iryani [1)*], Nurwahid Syam [2)]

Bina Adinata Institute of Technology and Business, Bulukumba, 92552, Indonesia

**Corresponding author: juniartiiryani1692@gmail.com*

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Abstract *– The rapid development of digital learning platforms, particularly Learning Management Systems (LMS) such as SPADA, has significantly transformed physics education by enabling interactive and flexible learning environments. However, the effectiveness of integrating online discussions and exercises in enhancing students' comprehension of physics concepts remains underexplored. This study aimed to evaluate the impact of online discussions and exercises conducted through the SPADA LMS on students' understanding of physics concepts. A quantitative approach with a one-group pre-test and post-test experimental design was employed, involving 18 students enrolled in a physics course. Data were collected using questionnaires, pre-tests, post-tests, and interviews. The results revealed a substantial improvement in students' comprehension, with the average post-test score (75.18) significantly exceeding the pre-test score (47.75). Students reported increased engagement, better conceptual understanding, and improved problem-solving skills through active participation in online discussions and structured exercises. However, challenges such as technical issues, including unstable internet connectivity, occasionally disrupted participation. Despite these obstacles, the integration of online discussions and exercises through SPADA LMS proved to be an effective strategy for enhancing students' comprehension of physics concepts and fostering a collaborative learning environment. This study highlights the potential of LMS platforms as essential tools for advancing digital education, with implications for improving instructional design and promoting interactive learning experiences in physics education. Future research should explore the integration of multimedia tools and adaptive learning features to further optimize LMS-based instruction in physics.*

Keywords: *digital learning; online discussion; online exercises; physics concepts; spada*

I. INTRODUCTION

The rapid advancement of educational technology, particularly through the integration of Learning Management Systems (LMS), has revolutionized higher education by providing more structured, interactive, and flexible learning environments (Putri et al., 2023). Platforms such as *SPADA* (*Sistem Pembelajaran Daring Indonesia* or Online Learning System) have emerged as essential

tools for facilitating digital-era education by bridging the gap between traditional classroom instruction and modern online learning approaches (Wulandari & Tohir, 2024). These systems empower students to access course materials, submit assignments, participate in assessments, and engage in meaningful discussions with instructors and peers, regardless of time and physical constraints (Sanjaya, 2020; Yusuf et al., 2019). Consequently, LMS platforms have become instrumental in addressing the increasing demands for flexible and student-centered learning in higher education

In the realm of physics education, where abstract and complex concepts often pose significant challenges, leveraging digital tools such as LMS platforms has become indispensable. Physics, as a subject, combines theoretical knowledge with experimental application, requiring students not only to comprehend abstract principles but also to develop problem-solving skills through active engagement and critical thinking (Onyema et al., 2019). Online discussions, as a core feature of LMS platforms, provide a collaborative space where students can interact with peers, share insights, and tackle challenging physics problems together (Kurniawan et al., 2016). These discussions go beyond simple knowledge-sharing; they create opportunities for students to engage in cognitive discourse, critically reflect on their understanding, and collaboratively construct knowledge. Research by Afriadi et al. (2024) highlights that active participation in online discussions significantly enhances student engagement and comprehension, as social interactions foster cognitive presence and a deeper grasp of subject matter (Asalla et al., 2014; Almareta & Paidi, 2020).

Equally important are online exercises, another vital component of LMS platforms, which serve as practical tools for reinforcing physics concepts and assessing students' comprehension in real-time. Online exercises often incorporate automated feedback mechanisms that provide students with immediate insights into their performance, allowing them to identify errors, clarify misconceptions, and improve their understanding iteratively (Susanti, 2021). Sofyatiningrum et al. (2019) demonstrated that structured feedback from online exercises significantly enhances students' academic performance by promoting active learning and self-regulation. Through repeated practice and targeted feedback, students not only refine their problem-solving abilities but also build confidence in tackling physics challenges.

The integration of online discussions and exercises within platforms such as SPADA represents a promising pedagogical approach to optimize physics education in the digital era. This combination fosters an interactive, engaging, and dynamic learning environment where theoretical principles are reinforced through collaborative discussions and hands-on exercises (Setiawan et al., 2023; Sabirova et al., 2018). Furthermore, this approach aligns

with the principles of contemporary education, which emphasize active learning, student engagement, and the practical application of knowledge (Vega et al., 2024).

However, despite the growing recognition of LMS platforms' potential, there remains a gap in understanding how specific tools such as online discussions and exercises can be effectively leveraged to optimize physics learning outcomes. The central research question of this study, therefore, is: How can the integration of online discussions and exercises through SPADA LMS optimize physics learning in the digital era? This question builds on prior findings by Sham & Iryani, (2024) who describe LMS platforms as essential tools for managing, delivering, and evaluating online learning effectively.

This study aims to evaluate the influence of integrating online discussions and exercises on students' understanding of physics concepts and their overall engagement in online learning environments. Specifically, it seeks to explore the extent to which these LMS features contribute to improving cognitive outcomes, fostering deeper conceptual understanding, and enhancing active participation among physics students. Furthermore, this research intends to contribute to the development of innovative online learning methodologies tailored to the unique requirements of physics education. By addressing these objectives, the study not only aims to provide empirical evidence on the effectiveness of SPADA LMS in supporting physics education but also offers practical recommendations for educators and institutions to optimize their use of digital learning platforms. Ultimately, this research aspires to serve as a reference point for designing and implementing future LMS-based learning strategies in physics courses, ensuring alignment with the evolving needs of 21st-century education.

II. METHODS

This study employed a quantitative approach with an experimental design to measure changes in students' understanding of Physics concepts following the implementation of online discussions and exercises via SPADA LMS. This experimental design enabled researchers to evaluate the impact of these methods on student learning outcomes (Syahrizal & Jailani, 2023). A one-group pretest-posttest design was used, involving measurements before and after the intervention of online discussions and exercises (Knapp & Faan, 2016).

1. Research subject

The study subjects comprised 18 students enrolled in a Physics course at the Bina Adinata Institute of Technology and Business, utilizing SPADA LMS as their online learning platform. These students actively participated in online discussions and completed online exercises as part of the learning process.

2. Research instruments

a. Interview questionnaire

This instrument assessed students' perceptions of online discussions and exercises conducted on SPADA LMS. It aimed to gather insights into students' attitudes, comfort levels, and perspectives regarding the effectiveness of these methods in enhancing their understanding of Physics (Ardiansyah, 2023).

b. Physics concept comprehension test

This test comprised questions designed to assess students' foundational and applied understanding of Physics concepts before and after the intervention (Yulisa et al., 2020). It served to measure changes in understanding resulting from the online discussions and exercises.

3. Research procedure

The research followed these steps:

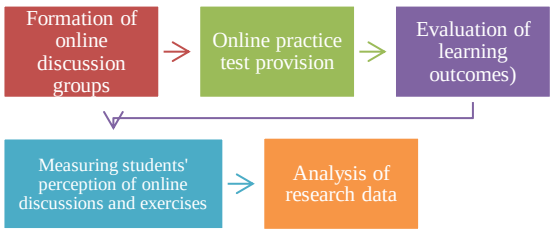

Figure 1. Research steps

4. Data analysis

Pre-test and post-test data were analyzed using descriptive statistics to provide an overview of student learning outcomes before and after the intervention (Nasution, 2017). Student interview data were analyzed thematically to identify key themes related to their experiences with online discussions and exercises on SPADA LMS (Abidin et al., 2020).

III. RESULTS AND DISCUSSION

This study presents data on the impact of online discussions and exercises via SPADA LMS on student Physics learning. The results of the research are divided into several aspects, namely:

a. Understanding physics concepts

Students' understanding of Physics concepts was measured using pre-test and post-test evaluations conducted before and after the intervention. The results indicated a substantial improvement in conceptual understanding following participation in online discussions and exercises. The average post-test scores significantly exceeded the pre-test score, demonstrating the positive effects of these strategies. This data is summarized in the table and histogram below:

Table 1. Pre-test and post test results data

Descriptive data	Pre-test	Post-test
Average	47.75	75.18
Standard Deviation	9.34	8.74

The following is also displayed a histogram of pre-test and post-test results.

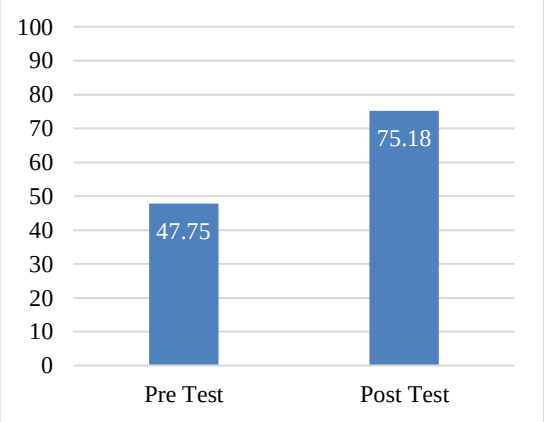

Figure 2. Histogram of pre-test & post-test results

As we can see in Figure 2, the data revealed a significant enhancement in students' understanding of Physics concepts, with an average score improvement of 27.43 points following the use of SPADA LMS. This finding aligns with a student's statement: "Online practice allows me to work on problems of varying difficulty. Initially, I made many mistakes but learned from them and improved." Online exercises provided practical experience, enabling students to better understand concepts and prepare for assessments. Analysis revealed that most students performed well in online practice sessions, with error rates declining over time. Direct feedback during these exercises helped students address and rectify conceptual misunderstandings.

b. Online discussion participation

Data from SPADA LMS revealed active student participation in discussions facilitated by lecturers. Frequent participation and substantial student commentary indicated strong engagement, contributing to improved understanding of Physics concepts. This aligns with a student's remark: "I always try to participate in discussions, even if my responses are brief".

Besides monitoring student activities on SPADA LMS, open interviews were conducted using questionnaires. Students expressed the benefits of online discussions, noting: "These discussions help me understand material more deeply as I can ask questions directly without feeling embarrassed. If I don't understand something, I can seek immediate clarification". However, challenges such as internet connectivity issues, which delayed responses in discussions, were also reported.

Students reported better understanding, opportunities for direct interaction with lecturers, and heightened learning motivation as key benefits. Nevertheless, technical challenges and self-doubt in expressing opinions were identified as significant obstacles. The data indicates that students generally had a positive response to online discussions in SPADA LMS, despite challenges that need to be addressed to enhance interaction quality further.

The findings of this study demonstrate that integrating online discussions and exercises in SPADA LMS significantly enhances students' understanding of Physics concepts. This aligns with the theory that social interaction in discussions fosters cognitive presence in online learning, leading to a deeper understanding (Hu et al., 2021). Open discussions allowed students to exchange ideas, facilitating a more profound comprehension of complex Physics concepts.

Additionally, regular online exercises with instant feedback have been shown to effectively improve student understanding (Rifky, 2024). Feedback after exercises enabled students to identify and correct misconceptions promptly (Paramita, 2023). The study further highlights that SPADA LMS effectively facilitates independent learning

while providing interactive support through discussions and exercises.

However, implementing this strategy revealed several challenges, including students' limited technical skills in optimally using LMS and internet connectivity issues that hindered access to materials and participation in discussions. Some students also reported challenges in maintaining consistent participation in scheduled discussions.

Overall, the findings endorse SPADA LMS as an effective platform for Physics learning in the digital era, utilizing the integration of online discussions and exercises to enhance concept understanding and student engagement. These findings are consistent with Novianti (2022), who reported improvements in student learning outcomes following LMS usage. Novianti's study measured changes using pre-tests and post-tests while analyzing internal, environmental, and instrumental factors influencing learning outcomes. This research further confirms the positive role of LMS in enhancing the Physics learning process within classroom settings.

IV. CONCLUSION AND SUGGESTION

This study offered strong empirical evidence highlighting the effectiveness of online discussions and exercises in SPADA LMS for improving students' comprehension of physics concepts in the digital era. The research results demonstrated a significant improvement in students' conceptual understanding following their participation in online discussion and practice activities. Online discussions created a platform for students to ask questions, exchange ideas, and understand concepts from multiple perspectives, while online exercises reinforced their understanding through practical application in problem-solving.

The increase in post-test scores compared to pre-test results demonstrates that these strategies not only support independent learning but also enhance student participation in the Physics learning process. Consequently, integrating online discussions and exercises into SPADA LMS is a highly effective strategy for fostering deeper understanding and mastery of Physics concepts in the digital era. Future studies could focus on evaluating and adding features to SPADA LMS, such as interactive simulations, experimental videos, or adaptive quizzes, to further enhance student engagement in the learning process.

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that the findings of this research will contribute to the advancement of science and technology, particularly in the field of physics education.

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