

Optimizing Hybrid Learning through the SPADA Platform to Enhance Pre-Service Teachers' Higher Order Thinking Skills in Supporting the Sustainable Development Goals

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Abstract: This study aims to analyze the optimization of hybrid learning through the SPADA platform in developing Higher Order Thinking Skills among pre-service teachers in the Physics Curriculum Analysis course. The study employed a quantitative approach using a descriptive research method. The participants consisted of 53 third-semester students of the undergraduate Physics Education Program, Faculty of Teacher Training and Education, University of Mataram, during the odd semester of the 2025/2026 academic year. The learning process was conducted over three months through the integration of face-to-face classroom learning and online learning using SPADA. Data were collected through a six-item essay test designed to measure higher-order thinking skills at the levels of analyzing (C4), evaluating (C5), and creating (C6). The data were analyzed using descriptive statistics, including mean score, minimum score, maximum score, learning mastery percentage, and grade distribution. The results showed that the average student learning outcome reached 87.91, with a minimum score of 83.45 and a maximum score of 88.95. The learning mastery percentage reached 100%, with 98.11% of students achieving grade A and 1.89% achieving grade B+. These findings indicate that hybrid learning is effective in developing students' HOTS while simultaneously supporting the implementation of SDG 4 in higher education.

Keywords: Hybrid learning; Higher order thinking skills; SPADA; Pre-service teachers; Sustainable development goals.

Introduction

Digital transformation in education has encouraged higher education institutions to develop learning systems that are more adaptive, flexible, and oriented toward the development of 21st-century competencies. These changes are driven not only by technological advancement but also by global demands for human resources who are capable of critical thinking, creativity, collaboration, and innovative problem-solving (Hikmawati et al., 2023). In the context of higher education, these demands are aligned with the global development agenda established by the United Nations through the Sustainable Development Goals (SDGs), particularly SDG 4, which emphasizes the importance of quality, inclusive, and sustainable education. For teacher education institutions, the implementation of SDGs is not only reflected in curriculum development but also in

innovative learning practices that equip students with academic, pedagogical, and professional competencies relevant to future educational needs (Harjono et al., 2024).

One learning approach that has emerged as a promising response to these challenges is *hybrid learning*. This learning model integrates the strengths of face-to-face instruction with the flexibility of online learning, enabling students to gain broader, interactive, and student-centered learning experiences. Face-to-face learning provides opportunities for direct academic interaction, conceptual discussions, and collaborative learning activities in the classroom, while online learning allows students to access learning materials, participate in asynchronous discussions, complete assignments, and engage in reflective learning more flexibly (Muhammad et al., 2025). At Universitas Mataram, the implementation of this model is supported

How to Cite:

Example: Susilawati, S., Doyan, A., Muliyadi, L., & Hakim, S. (2019). Growth of tin oxide thin film by aluminum and fluorine doping using spin coating Sol-Gel techniques. *Jurnal Penelitian Pendidikan IPA*, 1(1), 1-4. <https://doi.org/10.29303/jppipa.v1i1.264>

by SPADA as a digital learning platform that facilitates material distribution, discussion forums, individual assignments, quizzes, and various academic activities. The integration of digital platforms in hybrid learning provides lecturers with opportunities to design more structured, contextual, and engaging learning experiences (Sutrio et al., 2023).

In addition to supporting learning flexibility, the implementation of *hybrid learning* also has significant potential to enhance Higher Order Thinking Skills among students. HOTS refers to higher-level cognitive skills, including analyzing (C4), evaluating (C5), and creating (C6), which are essential competencies for pre-service teachers in the 21st century. Prospective teachers are not only expected to understand educational theories and concepts but also to analyze learning dynamics, evaluate curriculum implementation, and generate innovative solutions to educational challenges (Maryana et al., 2022). Therefore, learning in higher education should not merely focus on conceptual understanding but should also encourage students to think critically, argumentatively, reflectively, and productively through challenging academic activities (Hikmawati, Doyan, et al., 2024).

One course that plays a strategic role in developing the pedagogical competence of prospective physics teachers is *Physics Curriculum Analysis* in the undergraduate Physics Education Program at Universitas Mataram. This course is taken by third-semester students as part of strengthening their professional and pedagogical competencies in understanding educational curriculum systems. Through this course, students study the historical development of curriculum in Indonesia, the philosophical, psychological, sociological, and legal foundations of curriculum development, the urgency of curriculum reform in response to societal changes, comparative analysis of curriculum implementation, instructional approaches aligned with the national curriculum, learning models, instructional media development, assessment systems, and the analysis of instructional tools such as teaching modules and other curriculum implementation documents. Mastery of these topics is essential for prospective physics teachers, as curriculum serves as the fundamental basis for designing effective, contextual, and student-centered learning processes (Hikmawati et al., 2020); (Utomo et al., 2023).

However, the nature of the *Physics Curriculum Analysis* course, which requires students to analyze educational policies, evaluate curriculum implementation, and develop innovative instructional designs, demands learning strategies that can optimally engage students' intellectual involvement. In practice, higher education learning still faces challenges,

particularly the dominance of instructional activities focused on knowledge transmission and conventional discussions, which often limit opportunities for students to fully develop higher-order thinking skills. Academic activities that primarily emphasize conceptual understanding without the exploration of authentic cases may hinder the development of students' analytical and creative skills in addressing complex educational issues (Yusuf et al., 2021); (Umar & Ko, 2022).

Through the implementation of *hybrid learning* integrated with the SPADA platform, learning activities in the *Physics Curriculum Analysis* course can be designed more innovatively through case-based discussions, educational policy analysis, curriculum implementation evaluation, scientific article reviews, and the development of instructional solutions through HOTS-oriented individual assignments (Hikmawati, Rokhmat, et al., 2022). These activities enable students not only to understand curriculum content but also to critically examine educational policies, evaluate the relevance of curriculum implementation to physics learning needs, and design alternative instructional innovations that are aligned with contemporary educational demands. Third-semester students are in an important phase of developing their professional identity as pre-service teachers; therefore, engaging them in academic activities that require higher-order thinking from the early stages of their professional preparation becomes a strategic step in developing competent and adaptive graduates (Sulistyanto et al., 2023); (Zainil et al., 2023).

Therefore, optimizing *hybrid learning* through the SPADA platform in the *Physics Curriculum Analysis* course not only has the potential to improve students' learning experiences but also represents a tangible contribution of higher education institutions in supporting the implementation of the Sustainable Development Goals, particularly SDG 4, through the enhancement of higher education quality. Based on these conditions, an empirical investigation is needed to examine how the implementation of hybrid learning through SPADA can enhance the Higher Order Thinking Skills of pre-service teachers, particularly in the *Physics Curriculum Analysis* course, as part of the effort to achieve quality and sustainable education (Verawati et al., 2021); (Hikmawati, 2022).

Method

This study employed a quantitative approach with a descriptive method to analyze the implementation of *hybrid learning* in developing students' Higher Order Thinking Skills in the *Physics Curriculum Analysis* course. The study was conducted over three months during the odd semester of the 2025/2026 academic year, from

August to October 2025. It took place in the undergraduate Physics Education Program, Faculty of Teacher Training and Education, Universitas Mataram. The participants consisted of all third-semester students enrolled in the *Physics Curriculum Analysis* course, totaling 53 students (Creswell, 2012).

The learning process in this study applied a *hybrid learning* model by systematically integrating face-to-face and online learning. Face-to-face sessions were conducted in the classroom through activities such as concept exploration, group discussions, curriculum document analysis, presentation of findings, and reflective learning. Meanwhile, online learning was facilitated through the SPADA platform, which was used to upload learning materials, conduct case-based

discussion forums, assign individual tasks, review scientific articles, and collect assignments. All learning activities were designed to stimulate students' higher-order thinking skills at the levels of analyzing (C4), evaluating (C5), and creating (C6) (Simanullang & Rajagukguk, 2020); (Saputro & Susilowati, 2019).

The data focused on students' cognitive learning outcomes within the HOTS domain. The research instrument consisted of a six-item essay test, with two items measuring C4 (analyzing), two items measuring C5 (evaluating), and two items measuring C6 (creating). The instrument was developed based on the course learning outcomes and HOTS indicators in the revised Bloom's taxonomy. The blueprint of the HOTS instrument is presented in Table 1.

Table 1. HOTS Instrument Blueprint

Cognitive Level	Assessment Indicators	Description of Measured Competencies
C4 (Analyzing)	Identifying, differentiating, relating, and analyzing curriculum components	Students are able to analyze curriculum concepts, educational policies, implementation practices, and curriculum components based on educational cases or curriculum documents
C5 (Evaluating)	Assessing, critiquing, providing arguments, and making judgments	Students are able to evaluate curriculum implementation, the effectiveness of instructional models, and the relevance of learning tools based on educational data or phenomena
C6 (Creating)	Designing, developing, modifying, and generating solutions	Students are able to design instructional solutions, learning innovations, or curriculum-based instructional tools based on analytical findings

Each essay item was assessed using a 0–4 scoring scale based on the quality of students' responses. The HOTS assessment rubric is presented in Table 2.

Table 2. HOTS Assessment Rubric

Score	General Criteria	Assessment Description
4	Excellent	The response is complete, well-structured, argumentative, based on scientific concepts, and demonstrates in-depth analysis, evaluation, or creation.
3	Good	The response is sufficiently complete, logical, and conceptually accurate; however, the depth of analysis or argumentation is not yet optimal.
2	Fair	The response reflects partial conceptual understanding, with limited argumentation and insufficient depth of analysis.
1	Poor	The response shows limited conceptual accuracy, weak reasoning, and does not fully demonstrate HOTS competencies.
0	Very Poor	No response is provided, or the response is irrelevant to the given problem.

The maximum score for each essay item was 4, resulting in a total maximum test score of 24, calculated

by multiplying the total number of items (6 items) by the maximum score for each item (4 points). Furthermore, students' cognitive learning outcomes were calculated in percentage form by dividing the total score obtained by each student by the ideal maximum score, and then multiplying the result by 100 percent. In this study, the score obtained by each student represented the actual score from the essay test, while the ideal maximum score used as the reference was 24. The percentage scores were then converted into academic grade indices to determine students' learning achievement categories in the *Physics Curriculum Analysis* course. The criteria for converting percentage scores into academic grade indices are presented in Table 3.

Table 3. Academic Grade Conversion Criteria

Score Range	Grade Index	Category
85–100	A	Excellent
80–<85	B+	Very Good
75–<80	B	Good
70–<75	C+	Fairly Good
65–<70	C	Fair
55–<65	D+	Poor
45–<55	D	Very Poor
<45	E	Fail

Students' learning outcome data were analyzed using descriptive statistics, including mean scores, maximum scores, minimum scores, learning mastery

percentages, and grade index distributions. The results of this analysis were used to describe the effectiveness of *hybrid learning* implementation through the SPADA platform in enhancing Higher Order Thinking Skills among pre-service teachers in the *Physics Curriculum Analysis* course, while also contributing to the improvement of learning quality in alignment with SDG 4.

Result and Discussion

In the implementation of online learning, the *Physics Curriculum Analysis* course utilized SPADA as a learning management system that supports students' learning activities in a structured manner. Through this platform, lecturers managed various instructional activities using several available features. In the *resource* or material upload section, lecturers provided learning materials such as course modules, scientific articles, presentation slides, instructional videos, and supporting documents that could be accessed by students at any time. Furthermore, in the *discussion forum* feature, students were facilitated to engage in case-based academic discussions related to curriculum implementation, changes in educational policies, and the analysis of physics instructional materials. In this forum, students were encouraged to express their opinions, provide scientific arguments, and respond interactively to their peers' perspectives. In addition, through the *assignment* feature, lecturers assigned individual tasks and analytical projects oriented toward Higher Order Thinking Skills, allowing students to submit their work within the designated deadlines. SPADA also provides evaluation tools, student participation monitoring, and digital documentation of

learning activities, enabling the online learning process to be conducted more systematically, transparently, and effectively in supporting the academic competence development of pre-service teachers (Duin & Tham, 2020); (Aldiab et al., 2019). The discussion activities conducted through SPADA are presented in Figure 1.

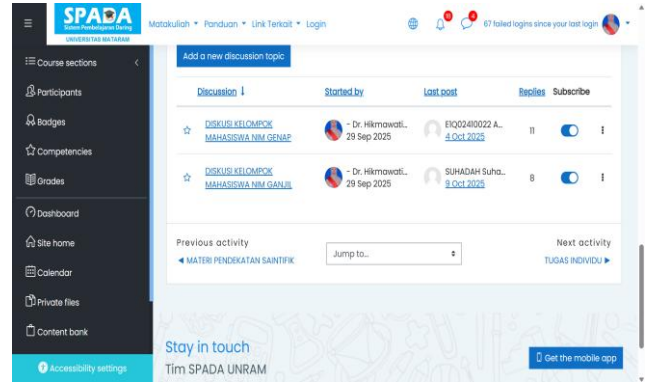


Figure 1. Discussion Activities on the SPADA Platform

The results of the descriptive statistical analysis indicate that students' learning outcomes were categorized as excellent. Based on the obtained data, the average student score reached 87.91, with the highest score of 88.95 and the lowest score of 83.45. All students achieved scores above the predetermined academic mastery criterion, resulting in a learning mastery percentage of 100%. These findings indicate that the implementation of *hybrid learning*, which integrates face-to-face classroom instruction with online learning through the SPADA platform, was able to effectively support the achievement of students' cognitive learning outcomes. The students' Higher Order Thinking Skills scores are presented in Figure 2.

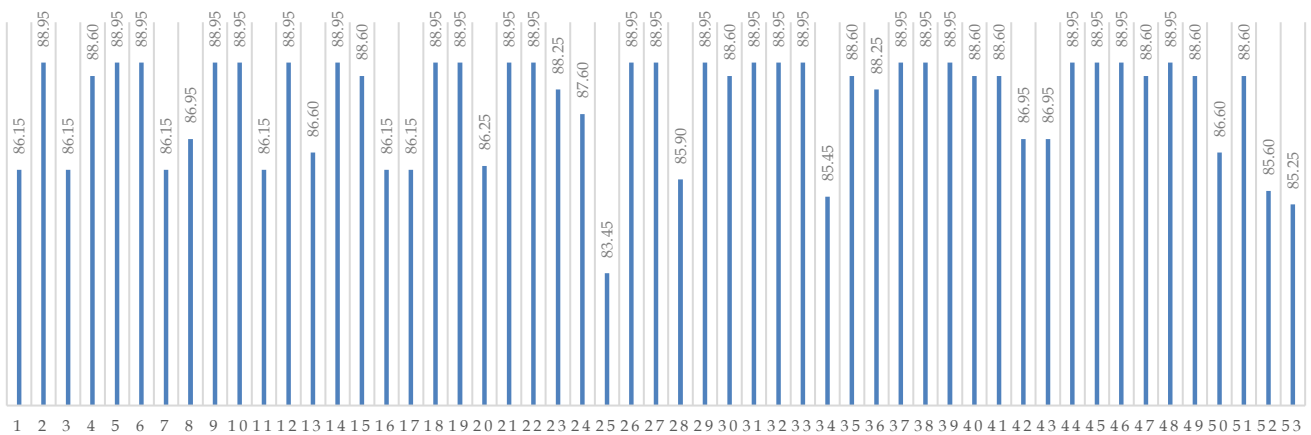


Figure 2. Students' Higher Order Thinking Skills Scores

The distribution of students' grade indices showed a highly dominant performance in the highest achievement category. Out of 53 students, 52 students

(98.11%) achieved grade A, while only 1 student (1.89%) obtained grade B+. No students were found to achieve

grades B, C, D, or E. The distribution of students' learning outcomes is presented in Table 4.

Table 4. Distribution of Students' Grade Indices

Grade Index	Number of Students	Percentage
A	52	98.11%
B+	1	1.89%
B	0	0%
C+	0	0%
C	0	0%
D+	0	0%
D	0	0%
E	0	0%
Total	53	100%

Overall, the findings indicate that the majority of students demonstrated an excellent level of mastery of the *Physics Curriculum Analysis* course content through learning activities designed based on Higher Order Thinking Skills principles. Students were able to analyze changes in curriculum policies, evaluate curriculum implementation in physics instruction, and design innovative solutions to educational problems through academic tasks assigned throughout the learning process.

The results of this study demonstrate that the implementation of *hybrid learning* made a positive contribution to the development of students' higher-order thinking skills. The high average learning outcomes indicate that the integration of face-to-face learning and online learning through the SPADA platform was able to create a more flexible, interactive, and student-centered learning experience. During face-to-face sessions, students had opportunities to engage in direct discussions, present the results of their analyses, and clarify concepts in depth (Madonna et al., 2025). Meanwhile, online learning through SPADA provided opportunities for students to explore learning materials, participate in case-based discussion forums, complete reflective assignments, and conduct independent academic inquiry more flexibly. The combination of these two learning modes enabled students to develop stronger and deeper conceptual understanding (Herwin et al., 2022).

These findings support the theory of *hybrid learning*, which suggests that the integration of synchronous and asynchronous learning can enhance student engagement, expand access to learning resources, and promote more independent learning. Students were not merely passive recipients of information but actively participated in the knowledge construction process through problem analysis, evaluation of educational policies, and the development of instructional solutions (Sembiring & Silaban, 2025). This is consistent with the constructivist perspective, which emphasizes that

knowledge is constructed through active learning experiences, social interaction, and academic reflection (Hikmawati et al., 2025).

The high level of learning achievement also indicates that the HOTS-oriented instructional design successfully encouraged students to develop higher-level cognitive skills. According to the revised Bloom's Taxonomy proposed by Lorin Anderson and David Krathwohl, the abilities to analyze (C4), evaluate (C5), and create (C6) represent key indicators of higher-order thinking required in 21st-century education (Listari et al., 2023). In this study, online discussions, scientific article analysis, curriculum document reviews, and case-based assignments enabled students to identify curriculum-related problems, evaluate instructional implementation, and generate innovative solutions relevant to the context of physics education. The dominance of grade A achievement indicates that most students were able to achieve HOTS indicators optimally (Hikmawati & Suastra, 2023).

In the context of the *Physics Curriculum Analysis* course, HOTS competence is highly essential for pre-service teachers. This course requires students not only to understand curriculum structures and components but also to analyze the dynamics of educational policy changes, evaluate curriculum implementation in schools, and develop instructional tools that align with students' characteristics and current educational demands (Hikmawati, Sutrio, et al., 2022). Third-semester students are in an important stage of developing their professional identity as future educators; therefore, engaging them in HOTS-based academic activities from an early stage represents a relevant strategy for fostering sustainable pedagogical and professional competence development (Malinao & Sotto, 2022).

The findings of this study also demonstrate strong relevance to the implementation of SDG 4 in higher education. One of the main targets of SDG 4 is to ensure access to quality education that fosters the development of relevant skills for life and the workforce. HOTS-oriented *hybrid learning* in the *Physics Curriculum Analysis* course represents a concrete implementation of this goal, as students not only gain mastery of academic content but also develop critical thinking, creativity, academic communication, and digital literacy skills. These competencies serve as essential preparation for future physics teachers in addressing increasingly complex and dynamic educational challenges (Noor Ismail et al., 2022); (Hikmawati, Kosim, et al., 2024).

Therefore, the results of this study confirm that optimizing *hybrid learning* through the SPADA platform can serve as an effective strategy for enhancing the Higher Order Thinking Skills of pre-service teachers. These findings highlight the importance of integrating

digital technology, HOTS-oriented task design, and globally responsive learning approaches as strategic efforts to improve the quality of higher education in alignment with the principles of the Sustainable Development Goals (Singh & Meena, 2022); (Budhyani et al., 2022).

Conclusion

The results of this study indicate that the implementation of *hybrid learning* through the SPADA platform in the *Physics Curriculum Analysis* course was able to optimize the development of Higher Order Thinking Skills among pre-service teachers. The integration of face-to-face classroom instruction with online learning through features such as material uploads, discussion forums, and assignments on SPADA provided students with a more flexible, interactive, and student-centered learning experience. The analysis revealed that the average student learning achievement was categorized as excellent, with a learning mastery percentage reaching 100% and a dominance of grade A at 98.11%. These findings indicate that learning activities designed based on HOTS at the levels of analyzing (C4), evaluating (C5), and creating (C6) were able to encourage students to think more critically, reflectively, and innovatively in examining various issues related to physics curriculum development. Therefore, optimizing *hybrid learning* through SPADA can serve as an effective strategy for improving the quality of higher education while simultaneously supporting the achievement of SDG 4 through strengthening the academic and professional competencies of future teachers.

Author Contributions

Conceptualization, H.H. and F.F.; methodology, H.H.; software, F.F.; validation, H.H. and F.F.; formal analysis, H.H.; investigation, H.H.; resources, H.H.; data curation, H.H.; writing—original draft preparation, H.H.; writing—review and editing, H.H.; visualization, F.F.; supervision, H.H.; project administration, H.H.; funding acquisition, F.F. All authors have read and agreed to the published version of the manuscript.

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Conflicts of Interest

The authors declare no conflict of interest.

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