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How to Promote Pedagogical Competence of Pre-Service Physics Teachers Through Case-Based Learning? An Action Research Evidence

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ABSTRACT (9 pt)

The demand to improve teacher competence arises in response to ongoing dynamics in the world of education, ensuring that teachers can provide quality and relevant instruction for prospective students. This study describes efforts to increase the pedagogic competence of Pre-service teachers through case based learning (CBL) to evaluate programs within the scope of education. This research is action research with stages of planning, action I, observing and reinforcement, action II, and evaluation. This research was conducted on 25 pre-service physics teachers of education study program at one of the state universities in Surabaya. Data were collected through observation, activity, and assignments. The collected data were analysed using descriptive statistics. Based on the results of data the pedagogic competencies of pre-service teachers have been successfully trained. Therefore, learning through group projects is very feasible to equip pre-service teachers with pedagogic competencies.

Keywords:

INTRODUCTION

In the 21st-century education era, lecturers play a strategic role in shaping the competence of prospective teachers by fostering creativity, innovation, and reflective abilities. Systematic research indicates that lecturer creativity is crucial in supporting students' professional development, particularly in fostering original and practical learning in higher education environments (Yudi et al., 2023). In addition, lecturers are also expected to develop research and innovation skills to create a dynamic learning environment, encourage problem-solving, and introduce the latest technology and methodologies in teaching practice (Olga et al., 2024). Improving the quality of teacher education programs through innovative and competency-oriented learning strategies is also a significant concern in various contemporary journals, which emphasize that the quality of lecturers as facilitators and mentors is the primary basis for producing educators who are prepared to address today's educational challenges (Weijing H and Nur Aira A., 2023).

Lecturers not only act as teachers (first-order educators) but also as guides to pedagogical expertise (second-order educators) who can serve as role models for quality teaching practices and encourage critical reflection in prospective teachers (Mattew J. K and Punya S., 2005). This is reinforced by research developed by Usman et al., which emphasizes the importance of developing lecturers' pedagogical competence through training, technological literacy, and increasing self-efficacy in designing learning designs that integrate TPACK (Technological, Pedagogical, and Content Knowledge) and assessment literacy, especially in the aftermath of the pandemic

(Usman et al., 2025). Higher education policies have also begun to focus on continuous lecturer development programs to prepare prospective teachers with academic knowledge, pedagogical skills, ICT literacy, and adaptability that align with future student needs (Kyparisia et al., 2017).

In today's era of rapidly developing technology, lecturers play a crucial role in developing the competence of prospective teachers by integrating technology and pedagogy. One form of lecturer dedication to technological development is through the use of media as teaching materials to support learning activities. The importance of the Technological Pedagogical Content Knowledge (TPACK) framework to help prospective teachers balance content, methods, and digital tools in planning and implementing learning (Arifudin et al., 2025). There is also the ICAP (Interactive Constructive Active Passive) learning model, which is also applied in professional development courses to increase the interactivity and critical reflection strategies of prospective teachers (Christiane et al., 2025). In addition to these two models, there are also practical and efficient learning strategies, such as collaborative design-based lesson planning and professional learning communities, which integrate technology into teaching practice (Kevin B and Amanda N, 2020). This will make it easier for lecturers to transfer knowledge and can facilitate the strategic application of active and collaborative learning that is relevant to digital transformation. In addition to the increasingly evolving learning model, teaching practices also need to be updated, considering the rapid advancements in science. Several current studies highlight the teaching practices of prospective teachers who utilize innovative technology. That is the importance of a strategic approach that makes technology a central component in the design and implementation of lecturer learning methods, so that it can produce prospective teachers who are ready to implement modern teaching practices (Michael, 2020).

In addition to studying models, strategies, methods, and learning techniques, lecturers must also prepare learning materials. For students to understand the basic concepts of a material, lecturers sometimes need to present it in detail and depth. For prospective teachers, these results must be studied and implemented to achieve effective and efficient teaching practices. In understanding a material, there are several ways to make it easier, namely by applying cognitive apprenticeship such as modeling, coaching, scaffolding, articulation, and reflection (Allan et al., 2018). In addition to the use of cognitive apprenticeship, instructional scaffolding has been shown to increase engagement and understanding of concepts when lecturers break down complex material into simpler parts and present it systematically (R Keith, 2005). In the realm of science, the concept of understanding material through academic portfolios is important as a reflective tool for compiling material and learning objectives in an authentic and meaningful manner (Carlos, 2025). Thus, thorough preparation includes the development of layered material, scaffolding guidelines, and means of reflection so that prospective teachers are ready to apply the material effectively in the field. In addition to emphasizing understanding the material, lecturers also need to implement effective methods to facilitate student understanding (Bonwell and Eison, 1991). Active

learning can enhance students' cognitive outcomes and has been demonstrated through several recent studies. In addition, the preparation of conceptual material accompanied by active learning methods, as well as technological design, can be an important basis for prospective teachers to understand and apply the material comprehensively (Syamdianita and Bambang, 2021).

However, behind the central role of lecturers in shaping the competence of prospective teachers, the reality of the world of education today still faces various fundamental challenges that have not been fully resolved. One crucial problem is the low relevance between the higher education curriculum and the real needs in the field, especially in the context of preparing future teacher professionalism (Viviana et al., 2021). The gap between higher education institutions and educational units in the field of teacher training is indeed a significant problem, mainly due to the weak collaboration that causes prospective teachers to lack authentic experience in real learning contexts. Research indicates that effective collaboration between universities and schools can foster a mutually supportive learning community, enhance the involvement of all parties, and promote the exchange of knowledge and ongoing professional development (Ragnhild J and May B. P ,2022).

In addition, the development of pedagogical competence of prospective teachers is often uneven due to limited evaluation and supervision methods in teacher education programs. Research shows that although prospective teachers generally master the teaching materials, they still feel less confident in applying teaching methods, classroom management, and integrating technology into learning (Ahmad Harun, 2025). Many prospective teachers still struggle to develop reflective and critical thinking skills, especially when facing complex learning problems that require context-based problem-solving. Research shows that the level of reflective thinking skills of prospective teachers is generally still moderate, and they are often unable to identify problems in depth, evaluate solutions, and explain the reasons behind the decisions taken (Òscar et al.,2020), (Muhammad Nur. K et al., 2021). This indicates that conventional learning approaches, which are one-way and less contextual, are no longer adequate in addressing the challenges of the 21st century.

Another challenge lies in the use of digital technology in education. Although the digital era has opened up great opportunities for interactive and flexible learning, many higher education institutions have not optimally integrated technology into the training process for prospective teachers (Itai Dubovi, 2022). The lack of technology-based training and the unequal distribution of digital literacy among lecturers and students are indeed serious obstacles to the implementation of innovative learning that is responsive to developments in the era. Studies show that structured digital training can significantly enhance the digital competence of lecturers and teachers, enabling them to integrate technology more effectively into the learning process. However, limited infrastructure, human resources, and a lack of ongoing training remain significant challenges, especially in educational institutions that have not fully transitioned to digital platforms (Siti et al., 2025), (Adrew et al., 2025). From this explanation, it is clear

that the world of education still faces structural and pedagogical problems that require strategic intervention. Therefore, a learning approach is needed that can address the need for contextual, collaborative, and real-world problem-based learning experiences to create competent and adaptive prospective teachers.

Recognizing the complexity of today's educational challenges, a learning approach is needed that is not only theoretical but also able to integrate real-world experiences into the teaching and learning process. One approach that has proven effective in improving the professional competence of prospective teachers is Case-Based Learning (CBL). CBL is a learning model that directs students to analyze, evaluate, and make decisions based on case studies that are relevant to real-world contexts. In the context of teacher education, this approach provides space for prospective teachers to develop reflective skills, problem-solving, and critical and collaborative thinking skills in situations that resemble real teaching practices (Kathy. L and Inae. C, 2008; I Gede et al., 2023; Ahmad. B and Hikmawati; 2024; Warinthorn et al., 2025).

Given the complexity of today's educational challenges, a learning approach is needed that is not only theoretical but also able to integrate real experiences in the teaching and learning process (Vincent et al., 2023; Catherine. T ,2025). One approach that has proven effective in improving the professional competence of prospective teachers is Case-Based Learning (CBL) (Melek S. A and Jason R. H, 2020; Olga Gould. Y and Xiaoyan. L, 2024). CBL is a learning model that directs students to analyze, evaluate, and make decisions based on case studies that are relevant to real-world contexts. In the context of teacher education, this approach provides space for prospective teachers to develop reflective skills, problem-solving, and critical and collaborative thinking skills in situations that resemble real teaching practices (Sarah et al., 2017; Peter et al., 2021; Ahmad. B and Hikmawati , 2024). Furthermore, this research aims to provide pre-service teachers with knowledge and understanding of how to develop effective teaching materials, equipping them with various essential skills that align with the competencies and characteristics of pre-service teachers in secondary schools.

RESEARCH METHOD

This type of research is linear action research because it consists of only one cycle (Ruchi et al., 2021). The stages in this research are planning, conducting, observing, providing reinforcement, and assessing, as shown in Figure 1.

The activities carried out at each stage of the research are as shown in Figure 1: (1) At the planning stage, the researcher prepares semester lesson plans, assessment instruments, and main topics for learning. (2) At the acting stage, the emphasis is on student activities, namely conducting learning with a CBL model; building knowledge, understanding, and skills. (3) At the observation and reinforcement stage, the researcher monitors and accompanies pre-service teachers, collecting preliminary design data. (4) At the Acting II stage, pre-service teachers continue learning with a CBL model while developing and revising the idea, (5) In the final stage, namely assessing, conducting a

final assessment including performance, presenting products, and answering guiding questions.

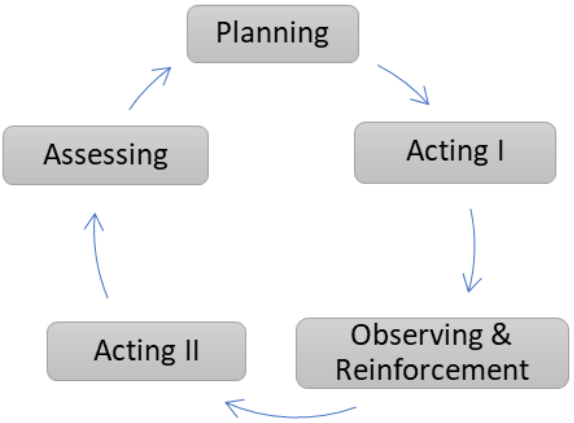

Figure 1. Research Design

The research was conducted in the Physics Education Study Program at a state university in Surabaya, Indonesia. The timeframe used in this research is one semester, or approximately four months. The population of this study consisted of pre-service teachers from the Physics Education Study Program who were enrolled in a course on developing physics teaching materials. The research sample consisted of 10 pre-service teachers selected through purposive sampling. Furthermore, the data obtained were processed and analysed descriptively. The results of the data analysis were divided into four categories: the value of participation and activeness at 70%, and the value of the task at 30%.

RESULTS AND DISCUSSION

At planning stage researcher compiles and designs activity plans for one semester as a reference for implementing learning. The results obtained from this stage are CBL learning implementation plan document. The summary of the implementation of CBL activities is divided into 16 meetings which are part of the learning stages that refer to CBL. The division of meetings is that out of 16 meetings, there are four meetings (meetings 1-8) for building knowledge, understanding, and skills; 4 meetings (meetings 9-10) were used to design; meetings 10-16) develop teaching materials.

Second stage, the lecturer provides knowledge related to the types of program evaluation. When learning, the lecturer also provides examples of each type of evaluation within the educational context. Strengthening this concept is carried out in 8 meetings. In the third stage, the teacher invites students to identify the program and plan how to properly evaluate it based on the reinforcement from meetings 1-8. In the fourth stage, the teacher invites students to evaluate the program that has been developed and compile learning materials. In the last stage, an evaluation is carried out related to the program that has been selected and implemented by students.

Based on the results of the literature review and findings from various studies, Case-Based Learning (CBL) is a practical approach for improving the competence of prospective teacher students. This approach is designed to address the main challenge in teacher education, namely the disconnection between pedagogical theory taught in class and real practices that occur in the field. In this context, the competencies in question include pedagogical, professional, social, and personality competencies as mandated in the teacher competency standards in Indonesia. CBL has been proven to enhance pedagogical competence, specifically the ability of prospective teachers to design, implement, and evaluate meaningful learning experiences. Through real case studies, students are positioned as decision makers who must analyze learning problems, formulate strategies, and consider their impact on students. Gravett et al. emphasized that CBL provides a simulated environment that allows students to experience instructional challenges in a safe atmosphere, thereby better preparing them to face reality in the classroom (Sarah et al., 2017). CBL is also able to strengthen professional competence, particularly in terms of critical thinking, reflection, and data-driven decision-making. Students who participate in case-based learning demonstrate an increased ability to evaluate alternative problem-solving approaches and develop more measurable and contextual learning strategies. This finding aligns with the results of Parwata et al., who stated that CBL can enhance metacognitive abilities, including planning, monitoring, and evaluating learning (I Gede et al., 2023).

In terms of social competence, CBL encourages students to engage in intense collaboration and group discussions. This enhances interpersonal communication and teamwork skills, which are essential for effective classroom management and collaboration among teachers. According to Sulé et al., case-based learning encourages active and participatory dialogue, enabling students not only to understand the material cognitively but also to build empathy for the diverse backgrounds of their peers (Vincent et al., 2023). CBL enhances personal competence because the learning process requires students to take moral and professional responsibility for their decisions. Students not only learn "what to do", but also "why to do it", which is the essence of forming integrity and reflective attitudes as prospective educators. CBL facilitates the formation of instructional leadership character because students are trained in making complex decisions based on pedagogical values and principles. Through analysis and discussion of real cases, students are faced with situations that require critical thinking, ethical considerations, and the application of leadership theory in the context of education (Kari F. V and Marit A., 2023).

In addition, CBL is also relevant to the challenges of the 21st century because it can be integrated with digital technology. Digitalization in the implementation of CBL, such as the use of online learning platforms and interactive case simulations, expands the learning experience of prospective teachers. Research shows that the implementation of digital Case-Based Learning (CBL) significantly improves the TPACK (Technological Pedagogical Content Knowledge) skills of prospective teachers, while making the learning process more immersive and flexible. Through the integration of technology, such as the use of digital platforms, simulations, and project-based learning, students not only master the material and pedagogy but also become skilled in utilizing

technology to support learning (Irdalisa et al.,2020), (Muhammad F., 2025). Thus, CBL not only improves one aspect of competence but simultaneously strengthens all domains of competence needed by future teachers. The integration of authentic experiences, critical reflection, decision-making, and technology makes CBL an effective, comprehensive approach to preparing prospective teachers who are adaptive and professional.

The implementation of the Case-Based Learning (CBL) approach in teacher education not only improves general competence but can also specifically enhance several key skills essential in teaching practice, including collaboration skills, analysis, problem-solving, conceptual understanding, and communication skills. The improvement of these skills is the result of the characteristics of CBL, which is based on authentic experiences, interactions, and reflective decision-making. CBL consistently improves the collaborative skills of pre-service teachers. In this model, students work in groups to solve case studies, discuss, and build a collective understanding of learning problems. This process encourages them to divide tasks, listen to one another, and combine their thoughts. Toogood stated that case-based learning facilitates the principles of active involvement and significantly strengthens the sense of collective responsibility in team learning (Catherine T., 2025). Analytical skills are also improved because CBL requires students to evaluate complex situations from various perspectives. Students must not only understand the facts presented in the case but also interpret the causes, consequences, and strategies for addressing them. This trains high-order thinking skills. A study by Willems et al. found that the use of authentic cases encourages students to think analytically in evaluating student needs and making data-based decisions (Peter et al., 2021).

Problem-solving skills are improved because CBL positions students as "professional problem solvers" who must produce practical solutions to instructional challenges. In practice, students are faced with real dilemmas that do not have a single definitive answer, so they must employ logic, empathy, and creativity. Students involved in case scenarios show significant improvements in designing solutions that are contextual and oriented to student needs (Melek S.N and Jason R.H, 2020). Not only that, but conceptual understanding also increases because case-based learning requires students to link theory with practice. CBL creates a contextual and meaningful learning environment, where pedagogical concepts are not only learned cognitively but also applied in real-life situations. Gravett et al. emphasized that the CBL approach provides a higher affordance (learning opportunity) for connecting theory and practice, which deepens the understanding of prospective teachers (Sarah et al., 2017).

Additionally, communication skills are enhanced because CBL relies heavily on verbal interaction and the presentation of ideas. Students are encouraged to express their views, explain learning strategies, and defend their arguments in class discussions and case reports. Involvement in case discussions improves teachers' professional communication skills, especially in explaining ideas systematically and actively listening to feedback (Olga G.Y and Xiaoyan L.,2024). The improvement of these various skills occurs because CBL operates on the principles of active, authentic,

reflective, and collaborative learning. Unlike conventional learning, which focuses on delivering information, CBL emphasizes the processing of information in real-world contexts. This is what makes CBL a strategic approach to producing prospective teachers who not only know "what to teach", but also "how, when, and why something is taught".

CONCLUSION

Based on the results and discussion, lectures with the CBL method have proven to be suitable for equipping prospective teachers with pedagogical competence. This competence is instilled through the process of working on projects and the resulting products. In addition to pedagogical competence, this lecture also develops various other skills, including collaboration and teamwork, interpersonal skills, problem-solving, independence, and graphic design. However, this study has limitations because it does not cover all aspects of pedagogical competence. The most prominent competencies include mastery of learning concepts, planning learning activities, and evaluating learning outcomes. Meanwhile, classroom management and learning implementation competencies have not been the primary focus. This study makes a positive contribution to the development of pedagogical competence in prospective teachers, and its lecture model can serve as a reference for similar courses. Further research is recommended to explore group project learning strategies that can develop various teaching competencies in an integrated manner without neglecting the final achievement of the course.

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