



ASSESSING THE EFFICACY OF LABORATORY IN ENHANCING STUDENT COMPETENCY: A COMPREHENSIVE EVALUATION

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Abstract. Laboratories in higher education not only function as practice spaces, but also as experiential learning platforms that play a crucial role in enhancing student competency. This study employed a descriptive approach with a CIPP (Context, Input, Process, Product) evaluative design in nine laboratories at the Faculty of Education and Psychology, Yogyakarta State University, through focus group discussions (FGDs), observations, and interviews. The results indicate that laboratories contribute positively to students' skills, creativity, and self-development, but still face limitations in terms of human resources, infrastructure, and the absence of national competency standards governing learning outcomes. The implications of this study emphasize the urgency of developing competency-based education (CBE) laboratories through improved facilities, managerial capacity, and nationally recognized competency certification, so that laboratories can function optimally as centers for competency development that are competitive both nationally and internationally.

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INTRODUCTION

Education plays a crucial role in instilling norms, socializing values, and shaping social work ethics. As part of the national education system, higher education plays a crucial role in enhancing the nation's intelligence while simultaneously developing science and technology through the application of humanitarian values, sustainable acculturation, and national empowerment (Paweenawat & Liao, 2023; Suardi et al., 2023). Technological developments in the millennial era have also had a significant impact on the learning process. Educational technology makes learning more accessible to all learners, including university students, while encouraging them to be more independent in their learning—a skill that is increasingly urgently needed in higher education (Auras et al., 2023; Goulart et al., 2022).

In this context, the Faculty of Education and Psychology of Yogyakarta State University (UNY) has a vision for 2025 to become a center of enlightenment and educational renewal that is superior, creative, and innovative, and based on dedication, independence, and intelligence. This vision contains eight keywords: center of enlightenment, educational renewal, excellence, creativity, innovation, dedication, independence, and intelligence. Optimizing the learning process is the first step to realizing this vision (Indrawati & Kuncoro, 2021; Velaora et al., 2022; Welch & Aziz, 2022). To that end, in addition to providing learning innovation units and workshops, the faculty also prepares laboratories as an important facility to support the quality of learning. As stipulated in Government Regulation Number 19 of 2005 concerning National Education Standards, every educational unit is required to have adequate infrastructure, including laboratories, to ensure the continuity of an orderly and sustainable learning process (Ben-Ellyahu, 2021; Liao et al., 2023).

Laboratories provide a platform for students to gain empirical experience and hone their skills. Through practical activities, students can develop creative thinking skills, curiosity, and problem-solving skills (Zhang & Ma, 2023; Henrique-Sanches et al., 2023; Hikmah Fatimah et al., 2021). Laboratories also contribute to the achievement of three educational objectives: affective, cognitive, and psychomotor, which serve as indicators of learning outcomes (Manurung,

2020;Agustian et al., 2022; Liu et al., 2022). Therefore, laboratories are not merely supporting facilities but also strategic learning resources that add value to study programs.

The application of theory through laboratory practice has been shown to improve processing and problem-solving skills while fostering students' interest and positive attitudes toward learning (Morris et al., 2021; Georgakopoulos et al., 2023). Laboratories provide authentic learning experiences, enabling students to deeply understand concepts through experiments and hands-on practice (Vázquez-Villegas et al., 2023). Therefore, laboratories can be viewed as a strategic component in the education system, particularly in higher education (Stollenwerk et al., 2022;Andi S, 2023). To achieve this function optimally, laboratory management must meet institutional quality standards, thus providing comfort and effectiveness in supporting teaching and learning activities.

Lecturers at the Faculty of Education continue to implement various learning innovations to improve student competency, including strengthening the curriculum, improving lecturer qualifications, and providing supporting facilities, including laboratories (Gugssa & Kabeta, 2021; Zabala & Dayaganon, 2023). However, although the role of laboratories has been widely discussed in the literature, there remains a research gap regarding how laboratories are evaluated for their effectiveness in improving student competency in the Faculty of Education and Psychology. Most studies focus on pedagogical functions or student perceptions, but few have presented comprehensive evaluations covering aspects of infrastructure, management, the quality of the management staff, and their relationship to national competency standards.

Therefore, this study aims to provide a comprehensive evaluation of the effectiveness of laboratories in supporting student competency development, highlighting the actual condition of laboratories, the quality of their management, and the opportunities for their integration with national certification schemes. Thus, this article contributes novelty in broadening the understanding of the strategic role of laboratories as instruments for strengthening the quality of superior, independent, creative, and competitive graduates in the 4.0 era.

RESEARCH METHODS

This study employed a qualitative approach with a descriptive evaluative design. The evaluation model used was CIPP (Context, Input, Process, Product) developed by Stufflebeam. This model was chosen because it provides a comprehensive overview of the laboratory's effectiveness in improving student competencies, including context, input availability, management processes, and the resulting outcomes (products). The subjects in this study consisted of various elements directly or indirectly involved in the management and utilization of laboratories at the Faculty of Education and Psychology., Yogyakarta State University (UNY). These elements included nine laboratory staff responsible for technical management, faculty leaders who act as policy makers, and lecturers who utilize the laboratory in the learning process. Furthermore, this study also involved students as laboratory users, with one representative from each study program in the faculty. Thus, the data obtained can provide a comprehensive picture of laboratory effectiveness from the perspective of managers, educators, policy makers, and primary users.

Data collection in this study was conducted using three main techniques. First, Focus Group Discussions (FGDs) involved student representatives from each study program, lecturers, laboratory staff, and faculty leaders. This activity was intended to explore in-depth the various perspectives, experiences, and obstacles encountered in laboratory utilization and management. Through focus group discussions, researchers were able to obtain richer information through interaction, exchange of ideas, and direct clarification among participants. Second, participant observation was conducted by directly observing the laboratory conditions in the Faculty of Education and Psychology. Observations focused on infrastructure, completeness of facilities, utilization of facilities, and the dynamics of ongoing practicum activities. This method enabled researchers to obtain a concrete picture of laboratory utilization in supporting the learning process. Third, documentation studies were conducted by reviewing various relevant documents, such as laboratory regulations and standard operating procedures, practicum activity reports, and data on



laboratory facilities and infrastructure. This document analysis provided supporting data to strengthen the results of the observations and group discussions and served as a reference for evaluating laboratory effectiveness.

Data analysis in this study was conducted using a descriptive qualitative approach. The analysis process began with data reduction, which involved selecting and sorting the most relevant information to the research focus regarding the effectiveness of laboratories in improving student competencies. The selected data was then compiled and organized according to the four main components of the CIPP model: Context, Input, Process, and Product. Through this organization, the data could be systematically arranged, facilitating an understanding of the relationship between actual laboratory conditions and the goals of student competency development. The next stage was drawing conclusions, which involved formulating research findings based on patterns, themes, and relationships emerging from the analyzed data. These conclusions served as the basis for evaluating the extent to which the laboratory functioned effectively in supporting student competency achievement at the Faculty of Education and Psychology., Yogyakarta State University. Data validity was maintained through source triangulation techniques (students, lecturers, staff, and management) and method triangulation (FGD, observation and interview). This ensures the data obtained is more reliable and reflects the actual situation.

RESULTS AND DISCUSSION

This study aims to evaluate the effectiveness of laboratories in improving student competency in the Faculty of Education and Psychology. The evaluation was conducted using a qualitative descriptive approach using the CIPP (Context, Input, Process, Product) model, which allows for a comprehensive assessment of the existence and utilization of laboratories. Laboratories are viewed as a strategic element in supporting curriculum implementation, particularly the Independent Learning – Independent Campus (MBKM) curriculum, which emphasizes experiential learning. The role of laboratories is crucial because they not only support theoretical mastery but also serve as a means of developing skills, creativity, independence, and student readiness to face the challenges of the 4.0 era.

The results of the study indicate that laboratories contribute significantly to improving student competency. However, several obstacles remain, including human resources, infrastructure, and competency development schemes that do not fully align with national standards. To provide a comprehensive overview, the research results are presented based on the four CIPP evaluation components: context, input, process, and product.

Context

The Faculty of Education and Psychology has a development orientation which is manifested in the tagline "Leading the Future of Education." This tagline inspires all academics to face the challenges of education in the 4.0 era which demands creativity, innovation and relevance to the latest developments. In line with this, the faculty has set a vision to become a superior, creative and innovative educational institution by 2025, while at the same time responding to society's needs for quality and adaptive education and psychology.

To realize this vision, the faculty implements various curriculum policies, namely the 2014 Curriculum, the 2019 Curriculum, and the 2020 MBKM Curriculum. These three curricula are designed to accommodate the principles of experiential learning with a learning-while-working approach. Through the implementation of this curriculum, students are expected to not only master theory but also be able to develop practical skills that are relevant to the world of work and the needs of society.

In this context, the role of laboratories is very strategic. The laboratory not only functions as a means of supporting learning activities, but also as a vehicle for strengthening student competencies through direct experience. The results of researchers' observations in several laboratories show that students are more active in experimenting, discussing and testing the application of theory in real situations. For example, in the microteaching laboratory, students appear to be involved in learning simulations that encourage courage, creativity and reflective abilities.



These observation findings were strengthened by the results of interviews with lecturers who emphasized that the laboratory acts as a "liberating space" for students to develop initiative and character. A laboratoran said, *"Through laboratories, students learn to make their own decisions, innovate and work together in teams. This is what we mean as a real implementation of Ki Hajar Dewantara's concept of independent learning."*

Thus, the combination of data from interviews and observations shows the triangulation of sources and techniques, while also confirming that laboratories are an important instrument in realizing educational goals that liberate and humanize humans.

Input

In terms of human resources, the Faculty of Education and Psychology has a total of 194 lecturers and 99 educational staff who support the implementation of the Tri Dharma of Higher Education. However, not all laboratories have the special staff to manage it fully. In practice, the responsibility for laboratory management still rests heavily on the head of the laboratory and the study program manager, so that technical management aspects cannot run optimally. This condition shows the need to increase the number of laboratory management staff with a more proportional distribution.

The results of an interview with one of the study program heads revealed that limited management staff meant that lecturers and students sometimes had to arrange their own laboratory usage schedules. This has an impact on reducing lecturers' focus in carrying out academic activities. One lecturer stated, *"We often have to manage laboratory techniques independently, even though ideally there would be special personnel to handle it."*

In terms of facilities and infrastructure, most of the nine study program laboratories already have adequate basic infrastructure, such as electricity, lighting and relatively good workspace. However, there are still limitations to essential facilities that support the learning process, such as projectors, tool storage and other technical equipment. Based on the results of the researcher's observations, in one laboratory practical tools were found that were placed openly because there was no adequate storage space. This condition not only reduces the tidiness of the room but also has the potential to disrupt the continuity of the practicum.

Furthermore, in terms of management qualifications and competencies, most laboratory personnel already have basic operational skills to carry out laboratory functions. However, these qualifications are not fully in accordance with the standards of laboratory managers in universities. This finding was confirmed by the results of an interview with an education staff who said, *"We can carry out basic laboratory functions, but for certain technical matters such as equipment calibration or practical module development, we still need special training."*

Thus, the combination of interview results and observations shows that there is a triangulation of resources and techniques, while also confirming that improving human resources, infrastructure, as well as increasing the qualifications of laboratory managers is an urgent need to support strengthening student competence.

Process

Students have utilized practical work and laboratory learning as a forum for honing and improving competence in their respective fields of study. The presence of laboratories provides opportunities for students to gain direct experience through practice-based learning. However, this utilization is still limited because there is no nationally standardized competency development scheme. As a result, learning outcomes in the laboratory have not been fully recognized as formally legitimized competency achievements.

The results of an interview with a student stated that practical experience in the laboratory really helped them understand the application of theory but often certificates or proof of achievement cannot be used officially outside campus. The student stated, *"We can practice directly, but unfortunately the results of this practice are not recognized as competency certification that we can show to the world of work."*

From a management perspective, the limited number of laboratory management staff is a significant obstacle. This condition has an impact on service quality, especially in terms of technical management of laboratory facilities. Apart from that, administrative obstacles such as



study load allocation, laboratory scheduling, and coordination between academic units often create challenges in the smooth running of laboratory activities. The results of the researcher's observations showed that there was an overlap in laboratory usage schedules in the two study programs, causing students to have to wait longer or postpone practical activities.

Despite facing various challenges, the faculty continues to strive to strengthen collaboration and networking with external parties. Until 2023, 906 domestic institutions and three foreign institutions have collaborated with faculties to support the implementation of the Higher Education Tri Dharma and laboratory development. This effort is expected to be an important asset in improving the quality of laboratory services through knowledge exchange, provision of facilities, and opportunities for student competency certification in the future. This is reinforced by the results of an interview with a faculty official who stated, *"Collaboration with external partners opens up student access to more modern facilities as well as certification opportunities that are recognized nationally and internationally."*

Thus, the combination of interview and observation results shows a triangulation of sources and techniques, while also confirming that laboratory development still requires strengthening governance, recognizing formal competencies, and optimizing collaborative networks.

Product

The laboratory has been proven to make a positive contribution to student self-development and competence. Through practicum activities, students can deepen theoretical understanding while honing skills relevant to their field of study. However, these competency achievements have not yet fully received formal recognition because there are no national competency standards that can be used as a reference. This condition reduces the legitimacy of student learning outcomes, especially when competing in the world of work which demands official certification of skills.

The results of an interview with a student showed that although practicum activities provided valuable experience, they found it difficult to show proof of competency recognition when applying for jobs. The student said, *"We have practical skills, but when we apply for work we ask for an official certificate. That's what we don't have yet."*

To overcome these challenges, a competency assessment system that is recognized nationally through the National Professional Certification Agency (BNSP) is needed. This system will be an important instrument to ensure student competency achievements are in accordance with industry standards and professional needs. However, the number of lecturers who have licenses as competency assessors is still very limited. Researchers' observation findings in one laboratory showed that when students wanted to take a competency test, they had to wait quite a long time due to limited assessors. This certainly hampers the certification process and reduces the effectiveness of formal recognition of student competence.

Furthermore, the results of an interview with one of the lecturers confirmed that increasing the number of certified assessors must be a priority. The lecturer said, *"If there are more competency assessors in the faculty, students will no longer have to wait long to be tested. This will also speed up the process of recognizing their competency according to national standards."*

Based on research findings, there are several important implications that need to be considered in future laboratory development. First, the provision of facilities and equipment must be adjusted to the needs of practical learning. Second, increasing the number and quality of laboratory management staff is important to guarantee professional services. Third, faculties need to develop student competency development schemes that are in accordance with national standards so that learning outcomes are more measurable and widely recognized. Fourth, increasing the number of licensed lecturers as competency assessors must be a strategic priority to support the sustainability of student certification.

The Role of Laboratories in Higher Education

The results of this study confirm that laboratories have a strategic role in improving student competency in the Faculty of Education and Psychology. The function of laboratories is not merely understood as a practical space for practicing technical skills, but rather as a vehicle for experiential learning that allows students to connect theory with real-world practice (Ali et al., 2022). From Kolb's perspective, direct experience in the laboratory is an important part of the experiential



learning cycle, which consists of four stages: concrete experience, reflection, abstract conceptualization, and active experimentation (Morris, 2020; Nurunnabi et al., 2022; Devi & Thendral, 2023). This process provides students with the opportunity to not only passively receive knowledge but also construct new meaning through repeated learning cycles.

Furthermore, Ruiying (Xu, 2017) emphasized that laboratories have a dual role: as a means of scientific research and a learning arena that fosters student creativity. Meanwhile, Xing-qiang et al (Teng & Yang, 2018) demonstrated that the existence of laboratories plays a role in preparing students to face increasingly complex professional demands. In other words, laboratories serve as a crucial bridge between the academic world and the needs of the workplace. This dual role provides a strong foundation for the Faculty of Education and Psychology to utilize laboratories not only as supporting facilities but also as a primary instrument in developing competent, adaptive, and relevant graduates to meet the challenges of education in the 4.0 era.

Relevance to the Faculty's Vision and *Ki Hajar Dewantara's* Ideas

The laboratory is also an integral part of the faculty's vision of "Leading the Future Education," a vision that places students as the primary subjects in the educational process, enabling them to face social, technological, and cultural changes in the 4.0 era. In this context, students are not only required to master theoretical knowledge but are also challenged to be creative, innovative, and adaptive in responding to current developments. The role of the laboratory is becoming increasingly vital because it provides a space for students to experiment, innovate, and test new ideas directly through practice (Wahidah et al., 2021). Thus, the laboratory can be seen as an arena for transformation that bridges the idealism of the faculty's vision with the reality of students' needs as future professionals.

Furthermore, the orientation of laboratory development is also closely aligned with the *Merdeka Belajar – Kampus Merdeka* (MBKM) policy, which emphasizes flexibility, autonomy, and freedom of learning. MBKM opens opportunities for students to learn from various sources and experiences, both inside and outside the classroom, one of which is realized using laboratories. This concept is closely aligned with *Ki Hajar Dewantara's* idea of freedom of learning, which emphasizes the importance of independence, responsibility, and character building as the primary goals of education (Efendi et al., 2023; Faradila et al., 2023; Idawati et al., 2025). In *Ki Hajar's* view, ideal education addresses not only cognitive aspects but also affective and psychomotor aspects. Therefore, laboratories function not merely as a means of mastering technical skills but also as a space for character building in students, fostering a fighting spirit, critical thinking, and the ability to collaborate. Thus, the integration of the faculty's vision, MBKM policy, and *Ki Hajar Dewantara's* ideas makes laboratories a crucial instrument in realizing a holistic and character-based education.

Resource and Management Challenges

However, in terms of input, this study also found serious limitations related to human resources and laboratory infrastructure. Not all laboratories have dedicated management staff fully responsible for the operation and maintenance of the facilities. As a result, the management burden is often borne solely by the laboratory head or study program manager, resulting in less-than-optimal governance effectiveness. This situation is exacerbated by limited physical facilities, such as a lack of supporting equipment for practicums, limited projectors for interactive learning, and a lack of adequate storage space to maintain the quality and sustainability of equipment. These obstacles prevent laboratories from fully functioning as centers for student competency development.

This limitation aligns with the findings of Gomez & Derr (2021), who emphasized that service quality is a key factor in the success of higher education management. If inputs in the form of human resources and infrastructure are not adequately managed, the quality of laboratory services will decline, ultimately impacting the student learning experience (Thi Chung & Thi Tram Anh, 2022; Rizal et al., 2024). This demonstrates that laboratory strengthening is not only about providing facilities but also involves sustainable management, including the recruitment, training, and development of management staff. In other words, without adequate resource support, laboratories risk becoming mere formalities rather than strategic tools supporting the faculty's



vision of producing competent, creative, and innovative graduates.

Learning Process and Technical Constraints

From a process perspective, laboratories have essentially been utilized by students as a learning platform, enabling them to gain practical experience in their fields of study. However, this research shows that this utilization still faces limitations due to the lack of a nationally standardized competency development scheme. As a result, the learning process in laboratories tends to be driven by the short-term needs of study programs and is not directed toward achieving widely recognized competencies. This creates a gap between the laboratory's immense potential as an experiential learning tool and the reality of its implementation, which is not yet systematically structured.

Furthermore, technical obstacles arise from the limited number of laboratory managers. The lack of competent human resources to support practicum activities results in low service intensity and limited student mentoring. At the administrative level, other issues such as practicum scheduling, faculty workload allocation, and cross-program coordination often present challenges that hinder the smooth learning process (Fauzi et al., 2024; Zeng et al., 2023). This situation prevents laboratories from fully providing in-depth and sustainable practical experiences.

However, as Edgar Dale emphasized through the cone of experience concept, direct experience through laboratory practice holds a crucial position as one of the most meaningful forms of learning (Cecep et al., 2024; Chan, 2022). Learning that involves physical involvement, observation, and real-life experiments allows students to develop a more comprehensive understanding than through text or lectures alone. With laboratories still facing technical constraints, students' potential to achieve a more concrete level of learning experience is hampered. Therefore, strengthening the learning process in laboratories requires not only technical and administrative improvements but also the structuring of a national competency-based learning scheme so that laboratories truly become meaningful learning facilities in accordance with the principles of experiential learning.

Contribution to Student Competence

Laboratories have been proven to significantly contribute to the development of student competencies, including technical skills, creativity, and soft skills such as communication, collaboration, and problem-solving. Through practical activities, students not only connect theory with practice but also prepare themselves to face professional and social challenges in the era of disruption (Noris et al., 2022; Rayna & Striukova, 2021). Thus, laboratories play a strategic role in developing graduates who are adaptable and relevant to the needs of the workforce.

However, formal recognition of student competency achievement remains limited due to the lack of national competency standards. This prevents acquired skills from being fully recorded or recognized as added professional value. This situation aligns with human capital theory, which emphasizes that knowledge and skills can only provide maximum benefits if formally recognized, for example through certification (Edeji, 2024; Griffen, 2024; Leoni, 2025). Therefore, the development of national competency standards is an urgent step to ensure laboratories truly function as drivers of human resource quality improvement.

Implications and Urgency for Future Development

The results of this study emphasize the importance of improving laboratory quality through several strategic measures. These efforts include providing adequate facilities and equipment, increasing and strengthening the competency of management staff, and developing a national standards-based student development scheme (de Matos & de Almeida, 2025; Al-Maskari et al., 2024; Mohamed Hashim et al., 2022). Furthermore, increasing the number of lecturers licensed as competency assessors is also urgent, given their crucial role in ensuring the credible certification process. Without support in these areas, laboratory functions could potentially be limited to routine practices without significantly impacting graduate quality.

This urgency aligns with the competency-based education (CBE) framework, which emphasizes that learning must be oriented toward achieving concrete, formally recognized skills (Rogers, 2021; Rhoney et al., 2024; Açıkgöz & Babadoğan, 2021). Through national competency



certification facilitated by official institutions such as the National Institute of Standardization (BNSP), laboratories can transform from mere practice spaces into centers for competency development with national and even international legitimacy. Thus, strengthening laboratories is not only an internal faculty need but also a strategic step to address global demands for professional and competitive human resources.

CONCLUSIONS AND SUGGESTIONS

This research demonstrates that laboratories in the Faculty of Education and Psychology play a strategic role in supporting student competency development, encompassing cognitive, affective, and psychomotor aspects. However, several input limitations remain, particularly related to the availability of management personnel, infrastructure, and the suitability of laboratory staff qualifications to national standards. Process-wise, laboratory use in learning has not been fully integrated with standardized competency development schemes, with technical and administrative constraints affecting learning effectiveness. In terms of products, laboratories have been shown to positively contribute to student skills and creativity, but formal recognition of these achievements remains limited due to the lack of national competency standards. Therefore, this study emphasizes the urgency of laboratory development through the provision of adequate facilities, increased management capacity, the development of national standards-based schemes, and the strengthening of the number of competency assessor lecturers. These efforts align with the competency-based education (CBE) framework, which positions competency certification as a crucial instrument for ensuring the quality of graduates, both nationally and internationally.

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