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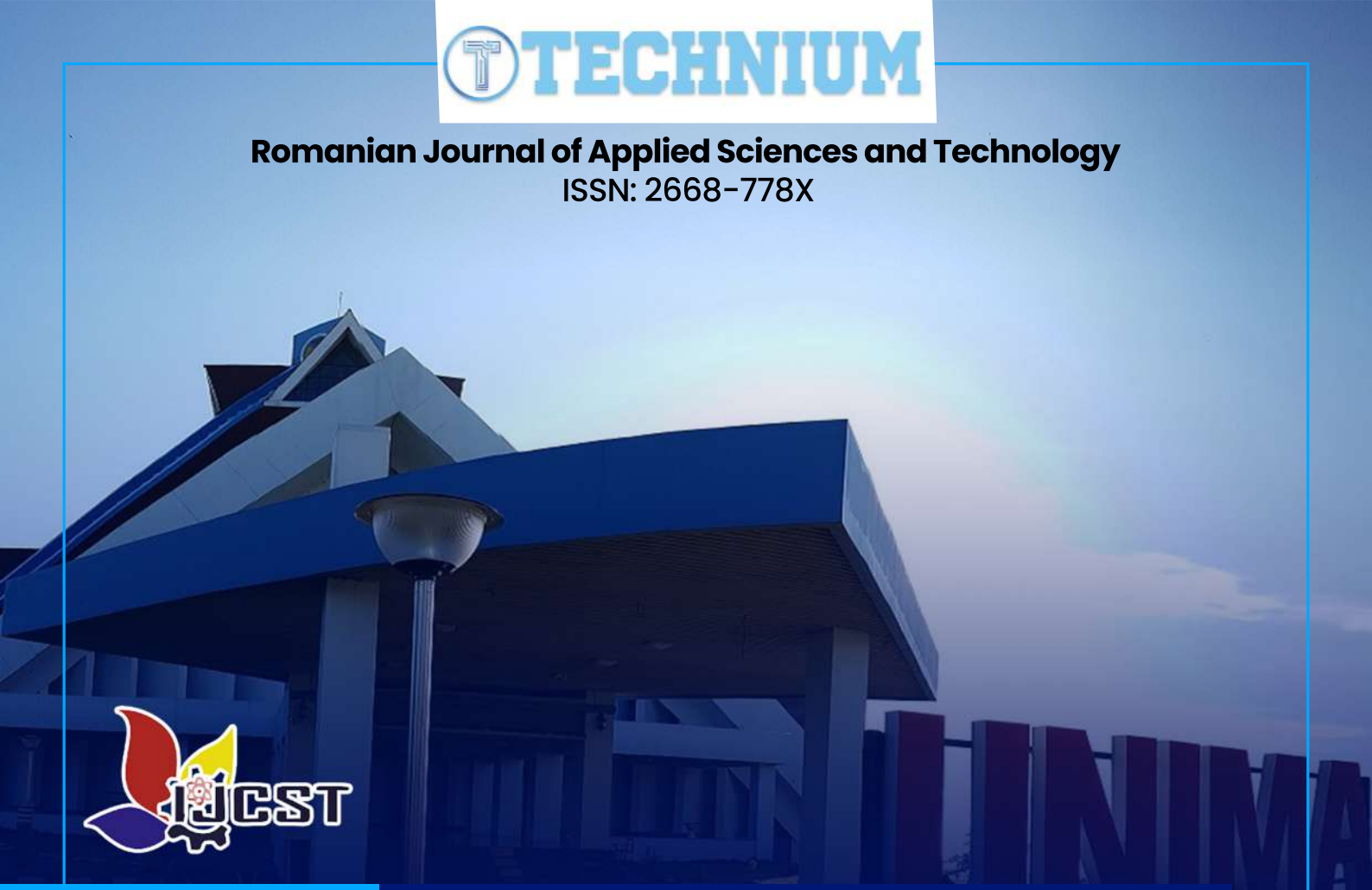

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The Effect of Educational Technology on Learning Facilities on Learning Independence to Improve Learning Outcomes of Building Construction Engineering Students

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Abstract. Building engineering education is a discipline that continues to develop along with technological advances. Educational technology, especially the integration of technology in learning facilities, has become an essential aspect in improving the quality of learning at various levels. This study aims to investigate the effect of educational technology on learning facilities on the learning independence of building engineering students and its impact on improving learning outcomes, especially in building construction subjects. This study uses a survey method, with a causal technique. The research sample will consist of final-semester students of the building engineering study program registered at a leading higher education institution. Data will be collected through an instrument in the form of a questionnaire to measure the level of student learning independence, as well as an evaluation test of learning outcomes for building construction subjects. Data analysis will be carried out using descriptive statistical methods to describe student profiles and analyze differences between the experimental and control groups. Furthermore, inferential analysis such as the t-test will be used to identify the effect of educational technology on learning independence and student learning outcomes. It is hoped that this research will result in a deeper understanding of how the integration of educational technology in learning facilities can influence student learning independence in the context of engineering education. The findings from this study can provide guidance for educational institutions in designing more effective learning strategies through the use of educational technology. In addition, this research is also expected to contribute to academic literature related to technical education and the use of technology in learning.

1 Introduction

Building engineering education has a central role in preparing students to become competent professionals in the field of building construction. In the current era of technology and information, the integration of educational technology into learning has become unavoidable. Technological developments have opened up new opportunities to increase the effectiveness and efficiency of the learning process at various levels of education. One area that is increasingly affected by technological developments is learning facilities. Effective learning facilities have an essential role in supporting the quality of learning. Learning facilities are no longer limited to physical spaces with blackboards and textbooks but also involve technological elements such as learning software, internet access, interactive multimedia, and online learning platforms. Technology integration in learning facilities has the potential to stimulate learning motivation, increase engagement, and assist in understanding complex concepts. One important aspect that needs to be considered in the learning process is student learning independence. Learning independence includes students' ability to organize and manage time, formulate learning objectives, find sources of information, and analyze and understand learning material independently. This ability is not only important in educational settings but is also a much-needed skill in the professional world, especially in the ever-growing building construction industry. In the context of building engineering students, expertise in building construction is at the heart of their course. Therefore, attention to learning outcomes in building construction subjects is very important. The integration of educational technology in learning facilities can potentially increase students' understanding and mastery of building construction concepts that are often complex.

However, despite the positive potential, the impact of the integration of educational technology in learning facilities on student learning independence and learning outcomes of building construction is not fully understood. Therefore, this study aims to fill this knowledge gap by systematically investigating the effect of educational technology on learning facilities on the learning independence of building engineering students and its impact on improving learning outcomes, especially in building construction subjects. With a deeper understanding of the impact of educational technology in the context of engineering education, educational institutions, and policymakers can design learning strategies that are more effective and in accordance with the needs of students and industry.

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This research will explore some of the problems that underlie the influence of educational technology on learning facilities learning independence and learning outcomes of building engineering students. Some of the problems that will be explained are: Student Learning Independence, namely How can the integration of educational technology in learning facilities affect the level of learning independence of building engineering students? Do students tend to be more active and play a role in managing their learning with access to technology in learning facilities? Utilization of Technology in Learning, namely To what extent has educational technology been used in the learning process of building construction? How do students respond to the use of technology to increase their understanding of complex concepts in building construction? The Effectiveness of Technology-Based Learning Facilities, namely Do technology-based learning facilities have a positive impact on students' ability to understand building construction materials? Do students who use technology-based learning facilities have better learning outcomes than those who don't? Obstacles in the Use of Technology, namely Are there any obstacles or obstacles in the application of educational technology to learning facilities for building engineering students? Do factors such as limited access, technological skills, or feelings of discomfort with using technology influence student learning experiences? The Relevance of Technology Integration with Industry, namely To what extent can the use of educational technology in building construction learning reflect the demands and needs of the industrial world? Does the use of technology in learning give students better readiness to face the challenges of the world of work in the building construction industry? Explanation and analysis of these problems will help gain a more holistic understanding of the influence of educational technology in learning facilities on learning independence and learning outcomes of engineering students. By identifying these problems, this research will make an essential contribution to designing learning strategies that are more effective and relevant to the needs of students and the building construction industry.

Although educational technology has become increasingly commonly used in learning environments, there are a number of knowledge gaps in the context of the influence of educational technology on learning facilities learning independence, and learning outcomes of engineering students. There are several research gaps that need to be looked into, such as the lack of specific research in the field of building engineering education.

Many studies have been conducted on the effect of educational technology on learning, but only a few have specifically studied the context of building engineering education. Research that focuses on the influence of educational technology on building construction subjects is still limited, even though this is a central aspect of the building engineering study program. Lack of understanding of the relationship between learning independence and technology, such as educational technology is often associated with learning independence, there is still no deep understanding of the extent to which educational technology can encourage student learning independence in the context of building engineering learning. Can technology integration really stimulate students to take independent learning initiatives? Lack of Understanding of the Impact on Building Construction Learning Outcomes, namely there is still little research that concretely measures the impact of the use of educational technology on student learning outcomes in building construction subjects. How can the use of technology in learning facilities improve students' understanding and mastery of building construction concepts? Lack of Understanding of Obstacles and Challenges, namely the integration of educational technology has great potential, there are likely to be obstacles and challenges that need to be overcome in its application. Limited access to technology, resistance to change, or discomfort in using technology may be an obstacle to the effective use of educational technology. Weaknesses of Studies that Involve the Industrial World, namely research that links the integration of educational technology with the needs of the industrial world, especially in the field of building construction, are still limited. How does the use of technology in learning reflect the demands and needs of jobs in the building construction industry? By filling in the knowledge gaps in these matters, this research will provide deeper insights into how the integration of educational technology in learning facilities can affect independent learning and learning outcomes of engineering students. Thus, this research will make a valuable contribution to the academic literature in the field of building engineering education and the use of technology in learning.

This research has several aspects that provide new and innovative contributions in the field of building engineering education and the use of technology in learning such as the Focus on Building Construction Subjects. This research directs attention to building construction subjects which are the core of the building engineering study program. The influence of educational technology on learning outcomes in subjects that have complex concepts and content will provide a more specific and contextual view. In addition, the link with independent learning, namely this research does not only focus on the impact of technology on learning outcomes but also considers student learning independence. The relationship between educational technology and the level of student learning independence in the context of building engineering learning has not been extensively explored, and this provides a more holistic approach to measuring the effects of technology integration. Next is Implementation in Building Engineering Education, namely educational technology has been widely researched, but its implementation in the context of building engineering education is still relatively rarely explored. This research will provide new insights into the specific ways in which educational technology can be applied in learning facilities to support building construction learning. Next is the Integration of Industry Aspects such as this research will explore the extent to which the use of technology in learning can reflect the demands and needs of the building construction industry. This will have a more practical and relevant

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impact on students' readiness to face the challenges of working in the field. In addition, an In-Depth Study of Obstacles and Challenges, namely this research, will not only focus on the positive potential of technology but will also explore the obstacles and challenges that may arise in its application. This will provide a more complete insight into the success or failure of using technology in building construction learning.

With a more specific focus, a holistic approach involving learning independence, application in the field of engineering education, integration with the industrial world, and an analysis of barriers and challenges, this research will provide new insights and a deeper understanding of the impact of educational technology in learning facilities on learning outcomes of building construction engineering students.

2 Method

The research method to be used is the survey method, with causal techniques (Sugiyono, 2017). In conducting data analysis, is there or is not the influence of one variable on other variables using path analysis, with the following structural model:

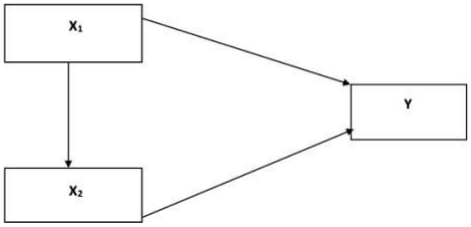

Figure 1. Structural Model of the Effect of Exogenous Variables on Endogenous Variables

Information:
Y: Student learning outcomes.
X1: Learning Facilities
X2: Learning independence.

The study, consisted of two exogenous variables as independent variables (causes), namely learning facilities (X1) and learning independence (X2), while endogenous variables were the dependent variable (caused variable), namely student learning outcomes (Y).

Research Place

This research was conducted in the Building Engineering Education Faculty of Engineering, Manado State University (UNIMA). Basic considerations chosen as a place of research; First, having a large enough number of students so that research can be carried out in one place. Second, students are relatively homogeneous, so they have the same characteristics. Third, students are on campus so that they can support the ease of conducting research. Fourth, the researcher is one of the lecturers who teach engineering at the Manado State Faculty of Engineering.

Research time

The research was carried out for approximately 4 months starting from March 2022 to June 2022. Prior to data collection, several preparatory activities related to research were carried out, such as compiling a theoretical framework and conducting seminars on theoretical studies to be used, then the preparation of instruments and instrument trials.

Population and Sample

The population in this study consisted of the target population, namely all students who sat in the even semester of 2021/2022 and the reachable population were students of the Building Engineering Education Study Program, Manado State University, who sat in semester VI of 304 students.

Withdrawal or making samples from the population to represent the population is due to raise research conclusions as something that applies to the population. This study took samples using a purposive sampling technique. In this study, the number of samples used was 100 (one hundred) or 33% of the total affordable population of 304 students of the Faculty of Engineering, Unima, Building Engineering Study Program, the same time to meet the requirements of path analysis.

Data collection technique

Data collection techniques in this study used a questionnaire with a Likert scale model. Meanwhile, student learning outcomes are taken based on the results of combining the value of learning outcomes from engineering courses

Reliability Calculations

Reliability testing is carried out to find out to what extent the results of a measurement can be trusted or reliable. The reliability of valid performance instrument items was analyzed using the Alpha-Cronbach technique. The calculation of the instrument reliability coefficient was carried out after the invalid items were not used in the study so they were not taken into account in this calculation. The reliability calculation was carried out using the SPSS For Windows program. Reliability is indicated by the number of instrument reliability coefficients with the Alpha Crombach formula as follows:

$$r_{11} = \left[\frac{k}{(}\right]\left[\sum\sigma\right.$$

Dengan keterangan :

r_{11} = instrument reliability

K = the number of questions or the number of questions

$\sum \sigma_b^2$ = number of variant items

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Based on the results of calculating the reliability of performance instruments, the magnitude of α = 0.948 is obtained. This means that performance instruments have fairly high reliability.

Validity Testing

Instrument validation was carried out by analyzing the relationship between the score of each item and the total score using the Pearson's Product Moment formula, from this calculation, it produced valid and invalid items, invalid instrument items were not used in the study.

The instrument is a questionnaire consisting of 30 statement items. The validity of the instrument items is determined by comparing the magnitude of the rxy obtained with the critical value of r Pearson Product Moment at n = 30, if r count □ r table, then the instrument items are valid and will then be used for data collection. Conversely, if r count <r table, then the item is not valid and will not be used in further research. In the table, the critical value of r table Pearson's Product Moment is known to be 0.36 for n = 30 with□ = 0.05. The instrument validity test was carried out with the help of Microsoft Excel. In order to test the validity of the items that have been prepared, the instrument trials are first conducted, then item analysis is carried out, namely by correlating the item scores with the total score of the instrument. For the purposes of measuring the validity of the instrument items, the Pearson Product Moment correlation formula is used as follows:

$$r_{tt} = \frac{\sum y_i y_t}{\sqrt{\left\{(\sum y_i^{\,2})(\sum_{Y_t}{}^{2})\right\}}}$$

Based on the calculation results obtained 28 valid items and 2 invalids (drop), namely; points 7 and 15. The recapitulation of the results of the validity test of the learning commitment instrument can be seen in Appendix 2, p.178. Research Instrument Trial Results.

Data analysis technique

Data analysis techniques in this research use path analysis to reveal whether there is a direct effect of each variable as previously hypothesized. The stages in data analysis techniques with path analysis techniques will be explained as follows:

1. In the early stages, perform a descriptive statistical analysis, by describing the data for each variable, through the average score, mode, median, standard deviation, variance, frequency, and histogram.
2. In this second stage, test the analysis requirements through the normality test of estimated error data with the Liliefors formula, significance test, and simple linearity regression as a continuation for hypothesis testing.
3. This third stage is the stage of disclosing the hypothesis using the "t" significance test analysis

3 Result and Discussion

3.1 Data description

1. Data on student learning outcomes

Data on student learning outcomes was collected through student documents based on odd semester final grades with score ranges showing between 58 – 84. The results of the data analysis obtained that the average score was 70.81, the standard deviation or standard deviation was 6.758, the median was 71, and the mode is 66. The number of classes is 7 and the length of the class is 4. The results of data processing are shown in the following frequency distribution table 1.

Table 1. Frequency Distribution of Student Learning Outcomes Scores

Nomor	Class Interval	Frekuensi Absolut	Frekuensi Relatif (%)	Frekuensi Kumulatif (%)
1	58 - 61	8	8.00	8.00
2	62 - 65	11	11.00	19.00
3	66 - 69	20	20.00	39.00
4	70 - 73	29	29.00	68.00
5	74 - 77	13	13.00	81.00
6	78 - 81	11	11.00	92.00
7	82 - 85	8	8.00	100.00
Jumlah		100	100	

Based on the mean value of 70.81 which is located in class intervals 70 – 71 it can be seen that 29 respondents (29.00%) score student learning outcomes the same as the average, 39 respondents (39%) below the average, and 32 respondents (32 %) above average. Furthermore, the histogram of this variable can be seen in Figure 2 below.

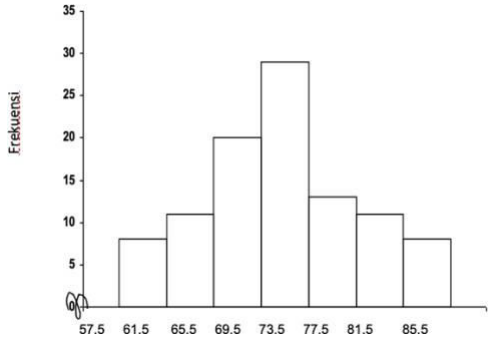

Figure 2. Histogram of student learning outcomes

Technium: Romanian Journal of
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3.2 Learning Facilities

Based on data on learning facilities collected through a questionnaire containing 27 statement items with a value scale of 1-5, indicating a theoretical range between 27-135. The answers given ranged from 105-132 with a range of 27. The results of the data analysis obtained that the average score is 119.77, the standard deviation or standard deviation is 7.11, the median is 120, and the mode is 122. The number of classes is 7 and the length of the class is 5. The results of data processing are shown in the following frequency distribution table 2.

Table 2. Frequency Distribution of Learning Facilities Scores

Nomor	Class Interval	Frekuensi Absolut	Frekuensi Relatif (%)	Frekuensi Kumulatif (%)
1	105 - 108	7	7.00	7.00
2	109 - 112	11	11.00	18.00
3	113 - 116	16	16.00	34.00
4	117 - 120	21	21.00	55.00
5	121 - 124	22	22.00	77.00
6	125 - 128	13	13.00	90.00
7	129 - 132	10	10.00	100.00
Jumlah		100	100	

Student learning facilities have a direct effect on student learning outcomes.

The results of testing the hypothesis support the positive direct influence of student learning facilities on student learning outcomes. This means that high or low-learning facilities have a direct effect on high or low-student learning outcomes. The more adequate learning facilities, the higher student learning outcomes. Conversely, the less adequate the learning facilities, the lower the student learning outcomes. The calculation results obtained path coefficient ρy2 = 0.189. Testing the hypothesis is carried out using the "t" test statistic with the provision that if the value of tcount > ttable then Ho is rejected, accept H1. From the calculation results it is known that the value of tcount = 2.826 at the significant level = 0.01 with dk = 99. This finding implies that student learning outcomes can be improved directly through student learning commitment.

Student learning independence has a direct effect on student learning outcomes.

The results of testing the hypothesis support the positive direct influence of student learning independence on student learning outcomes. This means that high or low student learning independence directly affects high or low student learning outcomes. The higher the student learning independence, the higher the student learning outcomes. Conversely, the lower the student learning independence, the lower the student learning outcomes. The calculation results obtained path coefficient ρy4 = 0.491. Testing the hypothesis is carried out using the "t" test statistic with the provision that if the value of tcount > ttable then Ho is rejected, accept H1. From the calculation results it is known that the value of tcount = 7.290 at the significant level = 0.01 with dk = 99. This finding implies that student learning outcomes can be improved directly through independent learning by students.

Learning facilities affect student learning independence

The results of testing the hypothesis support the positive direct influence of learning facilities on student learning independence. This means that the high or low learning facilities directly affect the high or low student learning independence. The higher the learning facilities, the higher the student's learning independence. Conversely, the lower the learning facilities, the lower the student's learning independence. The calculation results obtained path coefficient ρX42 = 0.211. Testing the hypothesis is carried out using the "t" test statistic with the provision that if the value of tcount > ttable then Ho is rejected, accept H1. From the calculation results it is known that the value of tcount = 2.130 at the significant level = 0.01 with dk = 99. This finding implies that student learning independence can be increased directly through learning facilities.

Implementation in Building Engineering Education

1. Introduction of Technology Integration in Learning Facilities

The results of the study show that the use of educational technology in learning facilities in the building engineering education environment has a positive impact on student learning independence. Students who have access to interactive learning software, multimedia content, and online learning platforms show a higher tendency to take the initiative in finding materials, organizing study schedules, and developing personal study plans.

2. Active Student Involvement:

This study reveals that technology-based learning facilities encourage students to be more active in learning. Students engage in online discussions, participate in learning forums, and utilize online resources to find out more about building construction topics. Thus, technology supports collaborative learning and more intensive discussions.

3. Increased Learning Independence:

Another important finding is that the use of technology in learning facilities has an impact on increasing student learning independence. Students become more accustomed to managing their own study schedule, selecting appropriate sources of information, and actively contributing to creating a learning environment that suits their personal learning style.

4. Positive Effect on Learning Outcomes

In terms of learning outcomes, this study shows that students who have full access to technology-based learning facilities have a significant increase in learning outcomes in building construction subjects compared to

those who do not have access. This shows that educational technology has the potential to improve students' understanding and mastery of complex concepts in building construction.

5. Challenges in Technology Implementation

However, this research also reveals several challenges in the implementation of technology in building engineering education. Some students have difficulty coping with complex learning software, while others are uncomfortable with the online learning environment. These factors suggest that despite the positive potential, the adoption of educational technology needs to take into account student diversity and ensure adequate support.

6. Relevance to the Industrial World

This research also shows that the integration of educational technology in building engineering learning is in line with the demands of the industrial world. Students who are familiar with technology in an educational context tend to be better prepared to face the changes and challenges that exist in the increasingly sophisticated building construction industry.

Thus, the results of this study provide in-depth insight into how the integration of educational technology in learning facilities can influence student learning independence and its impact on building construction learning outcomes. The implementation of technology in building engineering education not only increases mastery of concepts but also stimulates active participation and independent student learning. However, challenges in application and the need for adaptation to student characteristics need to be seriously considered in strategies for using technology in learning.

Integrating Industrial Aspects

1. Relevance to Industry Demands:

The results of this study reveal that the integration of educational technology in learning facilities in building engineering education has a strong correlation with the demands of the building construction industry. Students who engage in technology-enabled learning tend to have a better understanding of the latest developments in the industry, the latest safety standards, and innovative construction practices.

2. Relevant Skills Upgrading:

The integration of educational technology helps students acquire skills relevant to the needs of the modern construction industry. In this study, it was found that students participating in technology-based learning were more able to apply design and structural analysis software commonly used in the field, thereby giving them a competitive advantage in career preparation.

3. Deep Understanding of Practical Application:

The results showed that students involved in learning with technology gained a deeper understanding of the practical application of building construction concepts. They have the opportunity to interact with virtual simulations, describe and analyze real construction problems, and develop more effective solutions.

4. Connection with the Industrial World:

The application of technology in learning also strengthens the connection between the world of education and the world of industry. Collaboration with industry professionals in developing learning content, solving real project problems, and field trips equip student learning with practical insights that not only improve mastery of the material but also understand how these concepts are applied in the world of work.

5. Better Career Readiness:

Students who are involved in technology-based learning in the context of building engineering education are better prepared to face challenges in the building construction industry. They have relevant skills, practical understanding, and insight into the latest trends in construction, making them more recognized and desirable to potential employers.

6. Translation of Theory into Real Applications

The results of the study show that the use of educational technology helps students connect the theoretical concepts they learn with practical applications in industry. This creates a more holistic learning path and makes students better prepared to apply their knowledge to real challenges in the field.

Thus, the results of this study provide an in-depth understanding of how the integration of educational technology in building engineering education positively influences student readiness for the world of the building construction industry. By combining mastery of concepts, understanding of practical applications, and connectivity with the industrial world, students get real benefits in preparing for their careers and are able to face complex challenges in the field.

In-Depth Study of Obstacles and Challenges

1. Constraints in the Application of Technology

The results of this study highlight a number of obstacles that may be encountered in the application of educational technology in building engineering education. Students may encounter difficulties operating complex software, accessing online resources, or solving technical problems that may arise during the lesson. This shows that despite its positive potential, educational technology can present technical challenges for some students.

2. Resistance to Change

This study also found that some students may feel uncomfortable or reluctant to accept changes in the learning methods they are used to. It is possible that some students prefer traditional learning and show resistance to the integration of technology into the learning process.

3. Limited Access to Technology

Another challenge is limited access to technology. Students with financial limitations may face obstacles in obtaining the necessary equipment or accessing a stable internet connection. This can create gaps in the use of technology in learning.

4. Lack of Tech Skills:

Some students may also lack the technological skills needed to operate software or online learning platforms effectively. This can hamper their ability to make the most of technology-based learning facilities.

5. Need for Additional Support

This research also indicates that students may need additional support in overcoming these barriers and challenges. Technology skills training, technical support, or guidance from instructors can help students overcome these obstacles and be more confident in utilizing technology-based learning facilities.

6. The Importance of a Multiple Approach

In designing strategies for using educational technology, the results of this research underscore the importance of adopting a diverse approach to meet the needs of diverse students. A flexible and inclusive approach will ensure that all students can overcome barriers and challenges that may arise in adopting educational technology.

As such, this research provides in-depth insight into the barriers and challenges that can arise in the integration of educational technology in engineering education. Recognition of this challenge is important in designing effective and sustainable strategies to overcome obstacles that may arise in implementing educational technology so that all students can experience the benefits of using technology in the learning process.

4 Conclusion

This study provides important conclusions that provide in-depth insight into the effect of educational technology in learning facilities on learning independence and learning outcomes of building engineering students, namely the Integration of Technology in Learning Facilities, namely the integration of educational technology in learning facilities in building engineering education has a positive impact on student learning independence. Students tend to be more active in finding and managing information, designing personal study plans, and participating more intensively in the learning process. The use of technology in learning also has a positive impact on student learning outcomes in building construction subjects. Students who use technology-based learning facilities have a better understanding of complex concepts in building construction and achieve better learning outcomes compared to those who do not use technology. The findings from this study underscore the importance of integrating technology in building engineering education with the demands and needs of the building construction industry. Students who are familiar with educational technology have skills and insights that are more relevant to the requirements of the world of work. Despite its positive potential, the integration of educational technology also brings challenges. Students may encounter technical difficulties, resistance to change, or limited access. Therefore, an inclusive approach and an additional support approach are needed to overcome these constraints. The importance of diverse approaches to the use of educational technology is reflected in the results of this study. Every student has different needs and challenges, and a flexible approach should be adopted to ensure that all students can benefit from technology-based learning facilities. Thus, the conclusions of this study indicate that the integration of educational technology in learning facilities has a positive impact on the learning independence and learning outcomes of engineering students. This research provides valuable guidance for educational institutions in designing more effective learning strategies by leveraging the potential of technology. In addition, this research also highlights the need for harmony between education and industry demands, as well as the need to manage challenges in the application of educational technology so that all students can take maximum advantage.

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