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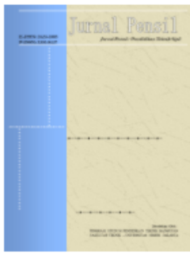

MODULE'S INFLUENCE ON BASIC ENGINEERING MECHANICS'S LEARNING OUTCOMES OF CIVIL ENGINEERING STUDENTS

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Abstract

Modules are teaching materials that contain learning objectives, learning material/substance and evaluation so that students can learn independently and be more active in learning. The purpose of this study was to determine the effect of using the module on student learning outcomes in first semester of the Civil Engineering Study Program, Faculty of Engineering, Graha Nusantara University in the Basic Engineering Mechanics course and the magnitude of the increase in learning outcomes. The research method used was quasi-experimental method with a pretest-posttest control group design. The number of samples is 40 students, which are divided into two groups. Data collection uses test techniques (questions) through pre-test and post-test. Data processing was performed using Statistical Product and Service Solution (SPSS) version 21.0 for Windows. Based on the results of the t-test, it was found that tcount ≥ ttable or 4.2058 ≥ 2.023 meaning that Ho is rejected or Ha is accepted. So that the module-based learning model affects the learning outcomes of Basic Engineering Mechanics students of the Civil Engineering Study Program, Graha Nusantara University Padangsidimpuan with an increase in learning outcomes of 41.86%. Meanwhile, the conventional learning model is only able to increase the learning outcomes of Basic Engineering Mechanics by 28.69%. The module-based learning model has a percent effectiveness of 35.19% to improve Basic Engineering Mechanics learning outcomes. Thus, the application of a module-based learning model is very suitable and effective for colleges used.

Keywords: Learning Outcomes, Basic Engineering Mechanics, Module, Percentage of Effectiveness, t-test

Introduction

Education has become a basic need to improve and develop the potential of human resources. Education aims to develop students' potential to become better human resources (Tania & Susilowibowo, 2017). In addition, education is also a survival technique for society, it is proven that society must adapt to the accelerated development of the times (Maulinda, 2022). Therefore, education plays an important role in improving human quality (Sari et al., 2022). At the same time, the important core of education is learning which must be meaningful (Rafi'y et al., 2022).

One effort to improve the quality of education is by improving the teaching and learning process. Therefore, lecturers are required to have patience, determination and openness as well as skills for more active teaching and learning situations. Lecturers can choose the right strategy to achieve learning objectives, including using appropriate teaching materials for learning (Asriyanti, 2018).

In learning activities, lecturers usually only use printed teaching materials, including textbooks or books. Textbooks in the world of education are a basic need for lecturers and students as a guide in learning activities so that they can achieve the expected qualifications (Wahyuni et al., 2018). Lecturers should have the expertise to develop teaching materials properly, but in reality, there are still many lecturers who have not mastered them. So there are still many conventions to complement the learning process (Subekti et al., 2018).

The effect of conventional learning is that lecturers are more dominant and students are less active because they are usually just listeners. In addition, learning becomes less interesting because learning is less varied (Sungkono, 2009). The development of teaching materials is very important as a lecturer to be able to use appropriate and up-to-date learning resources (Saifudin, 2020). Lecturers must know how to package the material that has been studied so that learning objectives can be achieved. The failure of lecturers to package learning activities encourages student learning outcomes. Therefore, lecturers are expected to know how to plan lessons well (Yustiana & Kusumadewi, 2020).

The development of science and technology also requires lecturers to always be creative in order to realize optimal learning outcomes for their students. The development of science and technology can play an important role in building knowledge by enabling the creation, management and transmission of knowledge(Zinnurain, 2021). The impact of science and technology development on the learning process is the enrichment of learning materials and media such as textbooks, modules, overhead transparency, film, video, television, slides, hypertext, web and others (Helmi et al., 2018). Learning resources must be able to meet the demands of learning materials because the low quality of learning resources causes low student learning outcomes. Some of the learning resources used for learning usually only provide information on subject areas and are not well organized.

Based on the results of the researchers' initial observations by looking at the final scores of students in semester I (one) of Civil Engineering for the 2020/2021 Academic Year (last year) in the Basic Engineering Mechanics course, it can be concluded that students who were declared successful or passed the course only 12 students out of 40 students (30%). Where students are said to be successful or pass in Basic Engineering Mechanics courses if students get a score of $\geq$ 60 which is the Minimum Completeness Criteria (MCC) score in lectures at Graha Nusantara University Padangsidimpuan. So the researchers took the initiative to improve the learning outcomes of Basic Engineering Mechanics Civil Engineering students in semester I (one) the following year by reconstructing the learning model that was originally carried out through conventional models with lectures, courses, records or notes and written assignments into a learning model that uses teaching materials instead of books. This is done so that students are more creative and not rely solely on lecturers.

One of the teaching materials that can be used as a substitute for a book is a module. Modules are teaching materials arranged in such a way that students can be independent with or without the guidance of a lecturer (Negara et al., 2019). The minimum module contains learning objectives, learning material/substance and evaluation (Frahatun et al., 2016). Modules function as media and teaching materials. As teaching materials, modules assist students in obtaining information about the material being taught independently (Pratita et al., 2021). Students who do not have teaching materials find it difficult to understand what is being taught (Sihotang & Cahaya, 2022). The application of the use of modules causes students to be more active in the learning process (Negara et al., 2019).

The preparation of all teaching materials is not perfect. Modules are complete teaching materials and are coherent programs in which learning objectives can be measured. Modules can be seen as program packages arranged into special units for learning purposes. So that the module can help overcome student difficulties when studying lecturer lecture material (Melinda et al., 2019).

With this module, it can be used as a substitute teaching material for lecturers. If the lecturer's job is to explain, then the module that will be made must be able to explain something in a language that is easily accepted by students. As a type of printed teaching materials, modules have four functions, namely independent teaching materials, substitutes for lecturer assignments, evaluators and student reference materials (Elya & Maulana, 2022). So it is necessary to do further research on the use of modules as teaching materials to improve student learning outcomes in semester I (one) of Civil Engineering Study Program, Faculty of Engineering, University of Graha Nusantara in Basic Engineering Mechanics course.

This study aims to determine the effect of using the module on student learning outcomes in semester I (one) of Civil Engineering Study Program, Faculty of Engineering, Graha Nusantara University in the Basic Engineering Mechanics course and the magnitude of the increase in student learning outcomes in semester I (one) of Civil Engineering Study Program, Faculty of Engineering, Graha Nusantara University in the Basic Engineering Mechanics course after implementing module-based learning. Thus, the research results to be obtained can be used as alternative learning that can be applied at the tertiary level so that students are more active and creative in managing independent learning.

The success of using module teaching materials to improve learning outcomes was shown by previous studies, namely research on the use of modules on mathematics learning outcomes for class VII students of SMP Negeri 8 Cirebon City which showed an increase in learning outcomes of 16% (Nuryana & Elinda Aprismayanti, 2013). Research on the use of modules on science learning outcomes for fifth grade students at SDN Petemon Surabaya City showed an increase in learning outcomes of 28.9% (Yanti, 2019). Research on the use of modules on mathematics learning outcomes for class X students of the Social Sciences Program at SMA Negeri 1 Kisaran also increased learning outcomes by 39.26% (Mapilindo et al., 2021). A study on the use of biology modules for class XI IPA students at SMAN 4 Pandeglang showed that 80% were media experts, 74% were material experts, 91% were biology teachers and 83.5% considered the biology module fit for use as teaching materials. Modules developed based on the answers of students who have become module users are included in the practical category (Sarwandi et al., 2019).

At the higher education level, the successful use of module teaching materials to improve learning outcomes is evidenced by research of Afifah (Afaf Afifah, 2020) which shows that the eligibility results of the electronic module for the Learning Competency course are media experts 87% and material experts 85.1% classified as very so that the teaching materials for the

Electronic Competency Learning Module are appropriate as a learning variant for lecturers and students.

The study by Hakim et al. (Hakim et al., 2021) shows that 79% of the feasibility results of the Digital Image Processing module are considered quite competent by media experts and 87.5% by material experts are considered very competent. After validation, the digital module was tested on 30 students with a very valid result of 87.9%. With an average validity value of 84.7%, the Digital Image Processing module developed in this study is definitely valid and can be used as a learning module. Research by Margaretta et al. (S. et al., 2018) shows that 78.3% of the feasibility results of the Basic Physics II module are assessed well by media experts and 79.4% by material experts. Therefore, the Basic Physics II module that was developed is suitable for use as a learning medium.

The study by Nadia et al. (Irmayanti & Suryani, 2020) found that the Basic Clothing learning module fulfilled the very good category with a percentage of 91.07% based on the results of the media expert test, 87.5% based on the results of the material expert test and 88, 33% based on the results of student responses to the Basic Clothing learning module. This makes the learning module suitable for learning Basic Clothing. Previously the use of modules as teaching materials was developed in other Civil Engineering courses, namely Soil Mechanics by Elvarita et al (Elvarita et al., 2020), according to him, these modules were suitable for use as teaching materials for Soil Mechanics courses. with a feasibility of results of 90.835% for media experts and 80.69% for material experts. So the average feasibility is 85.7625% with a very decent category. Therefore, the results of the research above strongly support the implementation of this research. Because module teaching materials can be used in various subjects or courses (Harahap, 2021).

Research Methodology

The research method used is quasi-experimental method, which is a research method that does not use random assignment but uses existing groups (Rahayu et al., 2019). The research was carried out at the Civil Engineering Study Program, Faculty of Engineering, Graha Nusantara University, Padangsidimpuan, Odd Semester for the Academic Year 2021/2022 in September-February 2022, with a sample of 40 first semester students.

Source of data obtained from the evaluation test at the end of the cycle. Data collection used test techniques (questions) (Arrumaisha et al., 2018). Before being tested, then 1 must first be tested for the validity, reliability, difficulty level and distinguishing power of the questions (Wahyuni et al., 2018). The design used in this study was a pretest-posttest control group design. In this design, two groups were selected, namely the experimental group and the control group, each consisting of 20 students. The experimental group will be taught through module-based learning and the control group through conventional learning with lectures, courses, records or notes and written assignment, each group using the Minimum Completeness Criteria (MCC) of 60 (Octaviani et al., 2019).

The module that will be used as teaching material for the experimental class is a module for the Basic Engineering Mechanics course which was developed by the researcher in accordance with the Semester Learning Plan (SLP) for the Basic Engineering Mechanics course which has been made specifically for the experimental class. The module was issued by the Civil Engineering Study Program, Faculty of Engineering, Graha Nusantara University Padangsidimpuan. The visualization of the cover module for the Basic Engineering Mechanics course used can be seen in Figure 1 below.

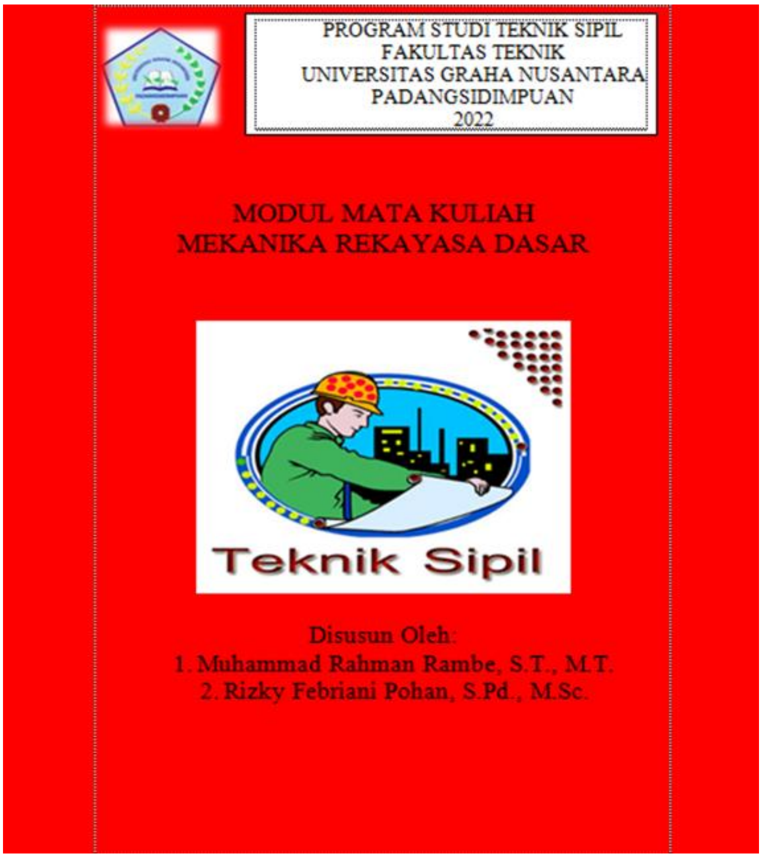

Figure 1. Module cover visualization

The Engineering Mechanics course module consists of 5 materials, namely: introduction, beams on two supports, lines of influence, multi-joint construction and portal construction. Because the modules are prepared based on the Semester Learning Plan (SLP), the use of the modules has been planned in the SLP. SLP illustrates that the lecture material delivered by the lecturer is in accordance with the contents of the module made. During lectures, the lecturer presents lecture material with power point slides, case studies and problem-based learning. Then, each experimental class student was given the task of practicing their skills in learning Basic Engineering Mechanics. They will study independently through the Basic Engineering Mechanics module course.

Whereas teaching materials for conventional classes are only the same material as the experimental class that students record directly when lecturers teach through lectures, lectures and written assignments. Each experimental group and control group were taught by the same lecturer/researcher. The stages in conducting research are (Pohan, 2017):

a. Prepare a Semester Learning Plan (SLP) for Basic Engineering Mechanics course for semester I (one) for each experimental and control group.
b. Carry out a pre-test with test material from Basic Engineering Mechanics teaching materials.
c. Dividing the sample into the control group and the experimental group.
d. Carry out the learning process for 16x100 minutes (16 meetings, 2 credits (@ 1 credit = 50 minutes)) for each group according to the lesson plan that has been made.
e. Carry out a post-test.
f. To tabulate and describe research data.
g. Testing the hypothesis, and
h. Prepare research reports for publication

The data obtained are data from student pre-test and post-test results. After doing research, obtained data to be processed and analyzed. Data processing was carried out using computer software, namely Statistical Product and Service Solution (SPSS) version 21.0 for Windows (Elvarita et al., 2020). To verify the hypothesis, the data were processed statistically in the following steps: 1) Calculate the normalized N-gain to determine the slope of the pre-test and post-test values of the two groups; 2) Normality test to find out whether the data distribution is normally distributed or not; 3) Test the homogeneity of variance to find out whether the variances of the two groups are the same or not (Rohmah & Wahyudin, 2017); 4) Test the hypothesis using the t-test if the data obtained is normally distributed and the Mann-Whitney test if the data obtained is not normally distributed (Rumanta et al., 2016).

Research Results and Discussion

Learning Outcomes of Basicc Engineering Mechanics Before Implementing the Module-Based Learning Model

Implementation of the pre-test aims to see the basic ability of students to understand the material being taught. Based on the results of the study of Basic Engineering Mechanics in general it can be said that the average pre-test scores of Basic Engineering Mechanics in the experimental and control groups were much different. The experimental group has an average score of 62.75 and the control group 59.5. Mathematically, the average difference in the Basic Engineering Mechanics pre-test score of the two groups is 3.25. After carrying out the pre-test, it was found that there were 12 students (60%) from the control group and 14 students (70%) from the experimental group who were successful in learning Basic Engineering Mechanics. Meanwhile, 8 students (40%) from the control group and 6 students (30%) from the experimental group were not successful in learning Basic Engineering Mechanics.

Based on the results of calculations using statistical tests using computer software, namely Statistical Product and Service Solution (SPSS) version 21.0 for Windows, it is known that the results of the Basic Engineering Mechanics pre-test in the control group and the experimental group are normally distributed and show a homogeneous variance. In detail, the results of the normality test and homogeneity of the pre-test data are presented in Tables 1 and 2, respectively, below:

Table 1. Pre-test data normality test

Group	X^2_{table}	X^2_{count}	α	Conclusion
Control	3.841	2.4147	0.05	Normal
Experiment	3.841	1.2861	0.05	Normal

Table 2. Pre-test data homogeneity test

Activity	F_{count}	$F_{left\ table}$	$F_{right\ table}$	α	Conclusion
Pre-test	0.7894	0.3479	2.874	0.05	Homogeneous

Learning Outcomes of Basic Engineering Mechanics After Implementing the Module-Based Learning Model

In the pre-test data analysis stage, it was found that the learning outcomes of Basic Engineering Mechanics in the control group and the experimental group were different. The post-test aims to see the level of understanding of students' Basic Engineering Mechanics concepts after learning takes place (Rohmah & Wahyudin, 2017). In addition, the post-test also aims to see an increase in the learning outcomes of Basic Engineering Mechanics for students of the Civil Engineering Study Program, Graha Nusantara University, Padangsidimpuan.

Based on the results of the study of Basic Engineering Mechanics in general, it can be said that the average post-test scores of Basic Engineering Mechanics in the experimental and control groups were much different. The experimental group has an average value of 76.25 and the control group is 68.25. Mathematically, the average difference in Basic Engineering Mechanics post-test scores of the two groups is 8. After carrying out the post-test, it was found that 14 students (70%) students from the control group and all students (100%) from the experimental group were successful. in learning Basic Engineering Mechanics. While 6 students (30%) students from the control group were declared not successful in learning Basic Engineering Mechanics.

Based on the results of calculations using statistical tests using computer software, namely Statistical Product and Service Solution (SPSS) version 21.0 for Windows, it is known that the results of the Basic Engineering Mechanics post-test in the control group and the experimental group are normally distributed and show a homogeneous variance. In detail, the results of the normality test and post-test data homogeneity are respectively presented in Tables 3 and 4 below:

Table 3. Post-test data normality test

Group	X^2_{table}	X^2_{count}	α	Conclusion
Control	7.815	3.3706	0.05	Normal
Experiment	3.841	3.0992	0.05	Normal

Table 4. Post-test data homogeneity test

Activity	F_{count}	$F_{left\ table}$	$F_{right\ table}$	α	Conclusion
Post-test	0.1427	0.4010	2.494	0.05	Homogeneous

Gain Analysis of Basic Engineering Mechanics Learning Outcomes

Analysis of the increase in Basic Engineering Mechanics learning outcomes in the control group and the experimental group was carried out by analyzing the N-gain data. Based on calculations, the average N-gain for the control group was 0.2869 and the average N-gain for the experimental group was 0.4186. According to the N-gain criteria, the learning outcomes of Basic Engineering Mechanics of the control group students were classified as low and the experimental group was at a moderate level. Mathematically, the N-gain of the two groups was significantly different, with a difference of 0.1317. The results of the N-gain analysis are presented in Table 5 below:

Table 5. n-gain analysis

Group	$\overline{X_1}$	$\overline{X_0}$	$\overline{X_m}$	G
Control	68.25	59.5	90	0.2869
Experiment	76.25	62.75	95	0.4186

By comparing the average difference between the pre-test and post-test scores of the control group and the experimental group, it is known that the percentage of effectiveness of the module-based learning model for Basic Engineering Mechanics learning outcomes is 35.19%.

Table 6. Percent effectiveness

Group	$\overline{X_d}$	% E
Control	8.75	35.19
Experiment	13.5	

Analysis of the Effect of Module-Based Learning Model on Learning Outcomes of Basic Engineering Mechanics

Because the learning outcomes of Basic Engineering Mechanics in the pre-test and post-test of the control group and the experimental group were normally distributed and showed the same variance, a parametric statistical test was carried out with the t-test as an influence test. The hypothesis test used is the t-test at a significance level of 5% (α = 0.05) and uses a minimum standard value ($\mu 0$) = 60.00 which is the standard value for stating that students have achieved 60% of the learning objectives according to the test rules which is correct. The hypothesis is formulated as follows:

Ho : μ = 60.00 (Module-based learning model does not significantly influence the learning outcomes of Basic Engineering Mechanics students of Civil Engineering Study Program, Graha Nusantara University, Padangsidimpuan).

Ha : μ > 60.00 (Module-based learning model significantly influences the learning outcomes of Basic Engineering Mechanics students of Civil Engineering Study Program, Graha Nusantara University, Padangsidimpuan). The results of the t-test are presented in Table 7 below:

Table 7. t-test result

Statistic test	t_{count}	t_{table}	α	Conclusion
t-Test	4.2058	2.203	0.05	H_0 rejected H_a accepted

From the results of the t-test performed, t_{count} = 4.2058 and t_{table} = 2.203, then $t_{count} \geq t_{table}$ which means Ho is rejected and Ha is accepted (Nuryadi et al., 2017). So the results of the study concluded that the module-based learning model had a significant effect on the learning outcomes of Basic Engineering Mechanics for students of the Civil Engineering Study Program, Graha Nusantara University, Padangsidimpuan.

Discussion

Based on the data processing of the pre-test and post-test results described previously, it shows that there is an increase in the learning outcomes of Basic Engineering Mechanics for students who are taught with a module-based learning model of 41.86%. The increase in Basic Engineering Mechanics learning outcomes with this module-based learning model is higher than conventional learning with lectures, courses, records or notes and written assignment which increases Basic Engineering Mechanics learning outcomes by 28.69%. Thus, the module-based learning model has a positive influence on improving the learning outcomes of Basic Engineering Mechanics for students of the Civil Engineering Study Program, Graha Nusantara University, Padangsidimpuan. The increase in student learning outcomes due to module-based learning obtained above is supported by research on Mathematics Education Study Program students, FKIP Unsri, which stated that the module-based learning model was able to improve student mathematics curriculum study learning outcomes by 33.34% (Aisyah & Purwoko, 2012). Research conducted on students of SMAN 5 in the city of Banda Aceh also showed that the module-based learning model was able to improve students' biology learning outcomes by 34.96% (Dewi & Abdullah, 2020).

Based on the research obtained, it appears that the learning outcomes of Basic Engineering Mechanics of students who are taught with a module-based learning model in the Civil Engineering Study Program, Graha Nusantara University Padangsidimpuan are better than the learning outcomes of Basic Engineering Mechanics of students who are taught with conventional learning models with lectures, courses, records or notes and written assignment. This is possible because the use of a module-based learning model can provide feedback so that students can identify their weaknesses and immediately make improvements and set clear learning objectives so that student learning is aligned with learning objectives. In addition, the modules are designed to be attractive(Aly Imron et al., 2022) and easy to learn (Rahmawati et al., 2019) and answer needs so as to motivate students to learn (Novia et al., 2022), modules are flexible because students can learn on their own at different speeds, minimize competition between students and allow remedial to be carried out.

Based on the information obtained on the learning outcomes of Basic Engineering Mechanics students of the Civil Engineering Study Program, Graha Nusantara University Padangsidimpuan, the group of students who were taught using the conventional learning model with lectures, courses, records or notes and written assignment achieved an average of 59.5 with a standard deviation of 11.28 in the pre-test. The group taught with the conventional learning model with lectures, courses, records or notes and written assignment obtained an average of 68.25 with a standard deviation of 13.40 after the post-test. Meanwhile, the group taught using the module-based learning model obtained an average of 62.75 with a standard deviation of 9.24 in the pre-test. After the post test was carried out, the group of students who were taught using the module-based learning model obtained an average of 76.25 with a standard deviation of 11.22. From this average score it can be seen that students who are taught with a module-based learning model have a higher average score than students who are taught only using conventional learning models with lectures, courses, records or notes and written assignment (Kholisho, 2017). The average learning outcomes of the experimental group after the post-test (76.25) were not significantly different from the results of research by Sani & Joko (Sani & Joko, 2015) which stated that the use of modules as teaching materials had an effect on student learning outcomes applied to the subject Electrical Machinery Maintenance and Repair courses of 77.91.

The results of the research data analysis show that the learning outcomes of Basic Engineering Mechanics of students who are taught using a module-based learning model in the Civil Engineering Study Program, Graha Nusantara University Padangsidimpuan are significantly different and better than the learning outcomes of students who are taught conventional learning models. Differences in Basic Engineering Mechanics learning outcomes can be seen from the average learning outcomes of Basic Engineering Mechanics between groups of students who are taught with a module-based learning model and groups of students who are taught with conventional learning. The result of t_{count} is 4.2058 > t_{table} 2.023, then Ho is rejected. So that the application of a module-based learning model has a positive effect on the learning success of Civil Engineering Study Program students at Graha Nusantara University Padangsidimpuan in Basic Engineering Mechanics. This means that the module-based learning model has a significant effect on improving the learning outcomes of Basic Engineering Mechanics for Civil Engineering Study Program students at Graha Nusantara University, Padangsidimpuan.

Based on the N-gain calculations of the control group and the experimental group, each obtained an average N-gain result of 0.2869 and 0.4186. This means that the quality of Basic Engineering Mechanics learning outcomes for the control group students is classified as low and the experimental group is moderate. From the results of data analysis it can be concluded that the module-based learning model is more effective than the conventional learning model in Basic Engineering Mechanics learning. Because the module-based learning model has advantages compared to conventional learning models, including: students can study independently without or with the guidance of lecturers and become more active in the learning process (Diana & Wirawati, 2021). In addition, the module encourages students to learn because it is packaged in an attractive way, the lecturer's insight is wider and expertise grows along with the development of science and technology (Belia et al., 2022).

This study shows that the percentage of effectiveness of the module-based learning model is 35.19% in improving the learning outcomes of Basic Engineering Mechanics for Civil Engineering Study Program students at Graha Nusantara University, Padangsidimpuan. The percentage of effectiveness of the module-based learning model obtained is not significantly different from the research results of Setiani et al. (2018), which states the effectiveness of learning through module teaching materials is 39%. The use of this module-based learning model also encourages students to study harder. The application of a module-based learning model is very appropriate and effective for use in tertiary institutions, which is based on the assumption that the optimization of student learning outcomes in Basic Engineering Mechanics is influenced by the learning conditions created by the lecturer in the classroom. Therefore, teaching is not always focused on lecturers as the main source of information, but lectures are the main choice of learning strategies that are usually applied in conventional classes. As stated by Wijaya & Vidianti (2019), module teaching materials are at a very good level of implementation and are effectively used as learning resources in tertiary institutions.

Conclusion

Based on the research results obtained, it can be concluded that the results of the t-test hypothesis test using a significance level of 0.05 indicate that $t_{count} \geq t_{table}$ or $4.2058 \geq 2.023$. This means that Ho is rejected or Ha is accepted. Thus, the module-based learning model has an impact on the learning outcomes of Basic Engineering Mechanics students of Civil Engineering Study Program, Graha Nusantara University Padangsidimpuan.

The effect that occurs through the application of a module-based learning model is an increase in the learning outcomes of Basic Engineering Mechanics for Civil Engineering Study Program students at Graha Nusantara University Padangsidimpuan by 41.86%. The percentage of the effectiveness of the module-based learning model is 35.19% which improves the learning outcomes of Basic Engineering Mechanics students of the Civil Engineering Study Program, Graha Nusantara University Padangsidimpuan. Therefore, the application of a module-based learning model is very suitable and effective for use by universities.

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