



ANALYSIS OF AUTODESK INVENTOR E-MODULE IMPLEMENTATION IN ENGINEERING DRAWING SUBJECT (CASE STUDY AT SMKS ALKHAIRAAT BAHODOPI VOCATIONAL HIGH SCHOOL MOROWALI)

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Informasi Artikel	ABSTRACT
<p>Riwayat artikel : Disubmit : 23 Desember 2023 Direvisi : 29 Februari 2024 Diterima : 5 Maret 2024 Dipublikasi : 15 Juni 2024</p>	<p><i>Learning media is very necessary in the learning process in vocational high schools. The development and use of e-modules is one effort to increase students' understanding of lessons. This research used experimental methods and was conducted at Alkhairaat Bahodopi Vocational High School in the 2023/2024 academic year. The sample selection was class XI TP 1 with 10 students as the control class and class XI TP 2 with 10 students as the experimental class. The design of this research is Pretest-Posttest Control Group Design. The research instrument is student learning outcomes. Hypothesis testing uses the paired sample t-test. The analysis was carried out descriptively. The research results show that the use of E-Modules affects increasing student learning achievement compared to learning without E-Modules. This is proven by the sig value < 0.001 for both knowledge and skills values in the experimental class, which shows that the sig value is smaller than $\alpha = 0.05$, so H_0 is rejected and H_a is accepted. The implementation of learning with Autodesk Inventor e-modules in class XI TP 2 made a positive contribution in improving students' academic achievement, especially when compared to the usual learning in the classroom.</i></p>
<p>Keywords: <i>E-Module, Engineering Drawing, Experimental, Learning Media, Vocational High School Students</i></p>	<p>ABSTRAK</p>
<p>Kata Kunci: E-Modul, Eksperimen, Gambar Teknik, Media Pembelajaran, Siswa SMK.</p>	<p>Media pembelajaran sangat diperlukan dalam proses pembelajaran di sekolah menengah kejuruan. Pengembangan dan penggunaan e-modul adalah salah satu upaya untuk meningkatkan pemahaman siswa pada pelajaran. Penelitian ini menggunakan metode eksperimen dan dilakukan di SMKS Alkhairaat Bahodopi pada tahun ajaran 2023/2024. Pemilihan sampel adalah kelas XI TP 1 sebanyak 10 siswa sebagai kelas kontrol dan kelas XI TP 2 sebanyak 10 siswa sebagai kelas eksperimen. Desain penelitian ini adalah Pretest-Posttest Control Group Design. Instrumen penelitian berupa hasil belajar siswa. Pengujian hipotesis menggunakan uji paired sample t-test. Analisis dilakukan secara deskriptif. Hasil penelitian menunjukkan bahwa penggunaan E-Modul berpengaruh terhadap peningkatan prestasi belajar siswa dibandingkan pembelajaran tanpa E-Modul. Hal ini dibuktikan dengan nilai sig < 0,001 baik nilai pengetahuan maupun ketrampilan pada kelas eksperimen, yang menunjukkan bahwa nilai sig lebih kecil dari $\alpha = 0,05$, sehingga H_0 ditolak dan H_a diterima. Implementasi pembelajaran dengan e-modul Autodesk Inventor di kelas XI TP 2 memberikan kontribusi positif dalam meningkatkan prestasi akademik siswa, terutama jika dibandingkan dengan pembelajaran yang biasa dilaksanakan di kelas.</p>



INTRODUCTION

Nowadays, education is an essential requirement for human life. The main objective of education is to develop human resources with high-quality skills and good character. In Indonesia, teachers are available at all levels of education, including kindergarten, elementary, middle school, high school, vocational school, and tertiary levels (Bafadhol et al., 2017). Through education, individuals can develop and improve themselves. Learning is a process of changing behavior through experience and interaction with the environment (de Houwer et al., 2013). It can be concluded that learning is a systematic communicative activity that takes place both inside and outside the classroom. It involves communication between teachers and students, as well as between students themselves. The ultimate goal is to master a particular skill or ability (Nugraha et al., 2018) .

Teachers as teachers must have useful innovations to help the learning process. Teachers who have a creative and innovative spirit can increase students' enthusiasm for learning and can help students' learning process so they don't get bored during the learning process (Marisana et al., 2023). If these aspects of learning can be fulfilled, students will be more independent, creative, and easier to accept the material presented during the learning process (Miftah, 2013). The implementation of learning must be well planned in order to provide the right service to the learners. for students. One of the supporting components for achieving learning objectives is the utilization of learning media. utilization of learning media (Anindya, 2023). However, the use of media can be a helpful tool for this purpose. Media can also make abstract concepts more understandable by providing concrete examples (Setiawan et al., 2021).

The current condition in the process of learning Technical Drawing activities at Alkhairaat Bahodopi Vocational School is that there are problems where teachers still teach using conventional learning in a direct learning system between teachers and students, making students less independent. Conventional learning that is still used by teachers is learning by giving direct explanations face to face. Students may become bored during lessons, particularly when they fail to take notes on the material presented by the teacher. This can lead to a lack of understanding, causing many students to fall behind in their studies.

The learning system uses the teacher to explain using PowerPoint, so the teacher will tend to passively pay attention to what is in front of him, whereas with Youtube, students will lose a lot of their quota for viewing tutorials, Therefore, it is necessary to have an E-Module in the learning process so that students can actively participate in the learning process independently without having to do face-to-face learning (Dion & Saputra, 2022). E-Modules are needed to expedite the learning process which is useful for assisting teachers in implementing Manufacturing Engineering Drawing learning,



where students have a handle containing materials and questions along with answer keys and steps to solve these questions.

The presence of certain issues has piqued the interest of researchers to conduct further research. Therefore, an idea was born to examine the implementation of the Autodesk Inventor E-Module in Manufacturing Engineering Drawing Learning at Alkhairaat Bahodopi Vocational School. E-Module was selected because of the numerous benefits of electronic facilities that many people use. It is expected that the E-Module used in learning will encourage students to be more active in the learning process because it consists of various Autodesk Inventor 2014 software-related materials. The purpose of the E-Module is to assist students who are struggling to learn subjects related to Autodesk Inventor Software.

In preparing the E-Module, researchers will prioritize more modern innovations, which will make it easier for teachers and students to use them, as well as make students more independent in ongoing teaching and learning activities. So, researchers conducted research with the title "Implementation of the Autodesk Inventor E-Module in Learning Manufacturing Engineering Drawing at Alkhairaat Bahodopi Vocational School".

RESEARCH METHODOLOGY

The method that will be used by researchers in this research applies experimental research methods. This experimental research will use two different groups, namely the control group, the experimental group (Firdaus, 2016). Experimental research can help establish cause-and-effect relationships, but requires careful consideration of variables, validity threats, and ethical considerations (Chinedum, 2014).

Experimental research is the only type of research that can test a hypothesis correctly. This experimental research will later aim to test how much influence one or more variables have on other variables (Rahman et al., 2022). Experimental research uses a method with Randomized Subjects, Pretest – Posttest Control Group Design, where two population groups for the research sample are selected randomly, and then given a pretest to determine the initial conditions. Next, there are differences between the experimental group and the control group. In this research, the E-Module as shown in Figure 1 is used for learning Autodesk Inventor in the engineering drawing course.

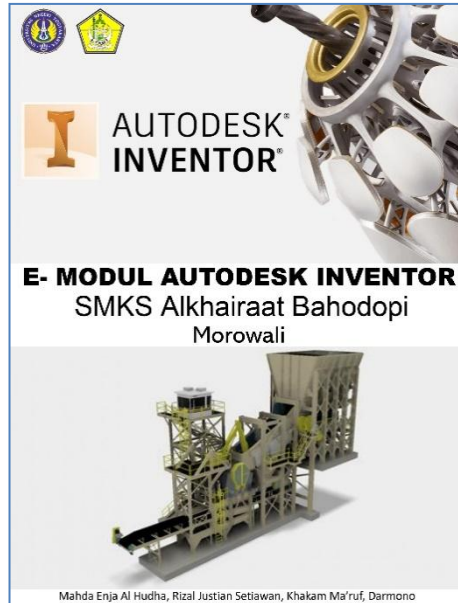


Figure 1. Cover of *E-Modul* Autodesk Inventor

1. Place and Time of Research

This research will take place in the Mechanical Engineering Study Program for two classes at XI TP 1 and XI TP 2 in Alkhairaat Bahodopi Vocational School (SMKS Alkhairaat Bahodopi). The school address is Padabaho, Bahodopi District, Morowali Regency, Central Sulawesi 94974. The research is planned to be carried out within a period of one month, on January 2023 in the 2023/2024 academic year.

2. Research Population and Sample

The population in this research case study were students of class XI TP 1 and class XI TP 2 of the Mechanical Engineering program at Alkhairaat Bahodopi Vocational School. The sample in this study as shown in Figure 2, used 10 students in class XI TP 1 students as the experimental group and also 10 students in class XI TP 2 students as the control group.



Figure 2. Samples in Classes XI TP1 and XI TP2 at SMKS Alkhairaat Bahodopi



3. Data Collection Techniques and Instruments

In this research, the first step of data collection is observation. Observation involves observing ongoing learning activities such as how teachers teach and how students learn. Observation has several advantages as a data collection tool. Firstly, it can collect a lot of information. Secondly, the results are more accurate and indisputable. Finally, research subjects cannot lie during observation. To make it easier to remember all events during observation, researchers also use cameras to document ongoing research activities. In this particular research, observations were carried out during classroom learning and when the experimental group (XI TP 2) was given treatment in the form of implementing the Autodesk Inventor E-Module.

The next step in this case study involves the use of a research instrument or data collection tool, commonly known as a test, to gather research data through measurements (Rizal et al., 2019). Testing is an important process used in various fields like education, psychology, and sociology to measure certain constructs. Constructs in the field of education can include skills, motivation, achievement of learning outcomes, students' talents and abilities, attitudes, and interpersonal relationships. Tests serve as measuring tools to help evaluate the desired construct accurately (Razali, 2021). Another opinion says a test is a series of questions or exercises or other tools that will be used to measure students' skills, knowledge, intelligence, and abilities or talents (Rapono et al., 2019)

4. Teknik Analisis Data

The data analysis technique in this research uses hypothesis testing. Hypothesis testing was carried out using the SPSS 27 Paired Sample T-Test program on the pretest and posttest scores for the experimental class and control class with a significance level of 5% (Latief et al., 2014). This test aims to determine the difference in the average score before being given treatment (pretest) and the average score after being given treatment (posttest) using the Autodesk Inventor learning e-module.

The hypothesis used in this research is:

H0: There is no increase in student learning achievement before being given the E-module and after being given the E-module.

H1: There is an increase in student learning achievement before being given the E-module and after being given the E-module.

Then, based on probability:

H0 can be accepted if it is significant $> 0.5\%$

H0 is rejected if it is significant $< 0.5\%$



RESULTS

The study was conducted by researchers as an experimental research. The experimental research took samples from two classes, XI TP 1 as the control group and XI TP 2 as the experimental group. The research was conducted over five meetings. The first meeting consisted of a Pre-Test, which lasted for 2 sessions of 45 minutes each. Following that, the students in XI TP 1 received the usual learning materials, while the students in XI TP 2 received the learning materials through e-modules. Finally, a Post-Test was held to conclude the research.

Observations were conducted in the experimental class (XI-TP4) to understand the e-module learning process. The objective was to observe the opening and closing of the lesson, teaching methods employed, principles used, media used, and evaluation techniques utilized during the implementation of the Autodesk Inventor e-module. The observation was conducted for 4 hours x 5 meetings.

During the first meeting, it was observed that students were highly enthusiastic about utilizing e-module media for their learning process. This was evident from the 100% participation rate in visual, listening, writing, motoric, and mental activities. However, in the case of verbal and emotional activities, such as question and answer sessions with teachers and amongst students, the participation rate was only 7.52%.

Observations at the second meeting showed that students were also actively participating in learning with e-modules. However, in the verbal and emotional aspects, students' interest is still lacking, as can be seen from the percentage of oral activities number 4 of 4.80%, number 5 of 0%, and emotional activities of 1.55%.

Observations at the third meeting showed that students were very active in participating in learning using e-module media. This can be seen from the percentage of 100% in the aspects of visual, listening, writing, motoric and mental activities. However, in the aspects of oral and emotional activities, students' interest is still lacking. For example, verbal activity number 4 is 4.80% and number 5 is 1.55%, and emotional activity is 2.85%.

During the fourth meeting, it was observed that students were highly engaged in various activities, achieving a 100% participation rate. However, they showed a lack of interest in verbal and emotional activities, with a 0% participation rate in those areas.

Similarly, at the fifth observation meeting, several aspects of activities achieved a 100% participation rate, but verbal and emotional activities remained suboptimal with participation rates of 0% and 4.80%, respectively.

Pre-Test and Post-Test are tools used to measure students' knowledge before and after a learning process. These tests were applied to both the control and experimental groups to compare the increase



in learning outcomes between the two. The implementation of Pre-Test and Post-Test in both groups was done in the same way. The main difference was in the method of delivering the learning material. The control group received standard lesson material, while the experimental group received an Autodesk Inventor learning e-module. The Post-Test results can be used to compare the students' understanding between these two learning models.

The standard passing score for the pre-test and post-test is 75. If a student has a score below 75 (score <75), then they are declared not to have passed. The following are the results of the comparison between the Pre-Test and Post-Test scores from the Kontrol class and the experimental class.

1. Class XI TP 1 (Control) Results

a. Knowledge Assessment

Table 1. Comparison of Score of Pre-Test and Post-Test Knowledge in Class XI TP 1

No	Performance	Pre-Test Score	Post-Test Score
1	Minimum Score	70	82
2	Maximum Score	100	100
3	Average	79.5	88
4	Completion Percentage	80%	100%

Based on the data as shown in Table 1, it can be concluded that there was an improvement in the Pre-test and Post-Test scores that assessed knowledge. The lowest score obtained by the students increased by 12 points, from 70 to 82, while the highest score remained constant at 100. Moreover, the average score increased by 9.5 points or 10.69%, from 79.50 to 88. The percentage of learning completion also significantly increased from 80% to 100% (all students passed), which is a 20% increase.

b. Skills Assessment

Table 2. Comparison of Score of Pre-Test and Post-Test Skills in Class XI TP 1

No	Performance	Pre-Test Score	Post-Test Score
1	Minimum Score	65	80
2	Maximum Score	90	95
3	Average	80.5	90
4	Completion Percentage	60%	100%

According to the skills assessment data as shown in Table 2, there was an increase in scores between the Pre-test and Post-Test. The minimum score obtained by students increased by 15 points, from 65 to 80, while the maximum score increased by 10 points, from 90 to 100. Moreover, the average score showed a significant increase, from 80.5 in the Pre-test to 90 in the Post-Test, which amounts to a 9.5 point increase or 11.8%. Then, there has been an increase in the percentage of learning completion from 60% in the Pre-test to 100% in the Post-Test, which means that all students passed. This shows a 40% increase in the percentage of learning



completion.

2. Class XI TP 2 (Experiment)

a. Knowledge Assessment

Table 3. Comparison of Score of Pre-Test and Post-Test Knowledge in Class XI TP 2

No	Performance	Pre-Test Score	Post-Test Score
1	Minimum Score	71	90
2	Maximum Score	90	100
3	Average	81.5	96
4	Completion Percentage	80%	100%

Based on the knowledge assessment data as shown in Table 3 gathered from the experimental class, it can be concluded that there was a significant increase in the learning outcomes scores between the Pre-Test and Post-Test. The minimum score increased by 19 points, from 71 on the pretest to 90 on the post-test. The maximum score obtained by students increased from 90 to 100. The average score also increased by 18.5 points or 22.69% from 81.5 in the pre-test to 96 in the post-test. Additionally, the percentage of learning completion increased from 80% in the Pre-Test to 100% (all students passed) in the Post-Test, which is an increase of 20%.

b. Skills Assessment

Table 4. Comparison of Score of Pre-Test and Post-Test Skills in Class XI TP 2

No	Performance	Pre-Test Score	Post-Test Score
1	Minimum Score	64	85
2	Maximum Score	87	100
3	Average	78	94
4	Completion Percentage	50%	100%

Based on the skill assessment data as shown in Table 4 for the Experimental class, it can be concluded that there was a significant improvement in the learning outcome scores between the Pre-Test and Post-Test. The minimum score increased by 19 points from 64 to 85, while the maximum score increased by 13 points from 87 to 100. Moreover, the average score increased by 16 points or 20.51% from 78 to 94. Additionally, all students passed the course as the percentage of completion rose from 50% to 100%.

3. Hypothesis Test Results

Testing from the group of students who received treatment with E-Modul (Class XI TP 2) in the final process of learning had a higher average score than the group of students who in the learning process did not use E-Modul (Class XI TP 1). The test results of students in class XI TP 2 (Experiment) using t-test with SPSS are shown in Table 5 and Table 6.



Table 5. Paired *t-test* Class XI TP 2 for knowledge

<i>Pre-Test & Post-Test</i>	N	t-count	Sig	Level of Significance
	10	-10.2	< 0,001	0,05

Table 6. Paired *t-test* Class XI TP 2 for skills

<i>Pre-Test & Post-Test</i>	N	t-count	Sig	Level of Significance
	10	-14.9	< 0,001	0,05

Based on the Paired Sample *t-test* Table data above, in the knowledge assessment, a significance value < 0.001 was obtained, meaning it was less than the significant value level (α) = 0.05, so the hypothesis H_0 was rejected. There was a significant increase in learning achievement between the average scores before and after the experimental treatment using E-Module. In Table t, the calculated *t* value is -10, meaning that the average before the treatment has a lower value than the average after the experimental treatment using the Autodesk Inventor E-Module. So it can be concluded that there was a significant increase in the knowledge learning results of the experimental sample class (XI TP 2) from the Pre-Test assessment to the Post-Test assessment.

In the skills assessment, the significance obtained was < 0.001 and less than the 0.05 significance level, so H_0 was also rejected. This means that there is a significant difference in learning achievement between before being given learning with the Autodesk Inventor E-Module and after being given learning with the Autodesk Inventor E-Module. So it can also be concluded that there has been a significant increase in the assessment of learning outcomes for Experimental class skills (XI TP 2) from the Pre-Test assessment and Post-Test assessment.

From the research data obtained, it can be assumed that the existence of learning media in the form of E-Modules in the Engineering Drawing Subject can improve student learning achievement. This fact is shown by the percentage increase in the average student score and the average student score after the post-test. The average scores obtained for the Control class (XI TP 1) were 88 (knowledge) and 90 (skills) with a percentage increase in scores of 10.69% and 11.8% respectively. Meanwhile, the average scores for the Experimental class (XI TP 2) were 96 and 94, with a percentage increase in scores of 22.69% and 20.51% respectively.

The research indicators were met in terms of student learning achievement in both the Pre-Test and Post-Test assessments. At least 80% of the total number of students in the class scored above the KKM threshold of 75. Furthermore, student activity improved with the use of Autodesk Inventor E-Module media during the 2023/2024 academic year at Alkhairaat Bahodopi Vocational School.



CONCLUSION

The Autodesk Inventor e-module was proven to have a large and significant influence on increasing the learning achievement of class XI TP 2 students at Alkhairaat Bahodopi Vocational School in Morowali, Central Sulawesi, when compared with class XI TP 1 as a control class without the use of any new learning media. This is proven by the increase in the average knowledge value of 22.69% and the average skills value of 20.51% in the experimental class XI TP 2 as the experimental class. The control class, XI TP 1 also had an increase but not significantly, amounting to 10.69% for knowledge scores and 11.8% for skills scores. This fact indicates that the implementation of learning with the Autodesk Inventor e-module in class XI TP 2 contributes positively to improving students' academic performance, especially when compared with ordinary learning implemented in class

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