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Effectiveness of Using Virtual Accounting Laboratory on Student Learning Outcomes

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Abstract

The research that has developed so far, the use of virtual laboratories in learning is only widely used for exact science groups such as mathematics, physics or chemistry, while in non-exact science groups it has not been widely done. Therefore, the purpose of this study is to determine the effectiveness of the use of virtual accounting laboratories on student learning outcomes in taxation courses which are non-exact science groups. This type of research is Quasi Experimental research using Nonequivalent Control Group Design. The results of the study showed that the post-test scores in classes that used virtual accounting laboratories increased higher when compared to classes that did not use virtual accounting laboratories. The contribution that is an important finding in this study is the use of virtual accounting laboratories for taxation courses which are non-exact science fields has been proven to be able to improve student learning outcomes.

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INTRODUCTION

Education is a hope for improving the quality of human resources. Through education, humans can find new things that can be developed and obtained to face existing challenges in accordance with the times. Therefore, education should be aimed at efforts to form humans who are responsive to the environment and sensitive to change. Science and technology directly or indirectly affect all aspects of life without exception in the aspect of education, namely the emergence of technological products that can be used in the learning process. Information technology can be used to improve the quality of human resources and will automatically affect the improvement of the quality of education (Rahayu et al., 2021). There are various learning strategies and methods to facilitate the learning process, so that optimal results can be obtained. With a clear strategy, the learning process will be directed and can run effectively and efficiently so that the learning objectives that have been set can be achieved.

Taxation courses are one of the compulsory courses that must be taken by students. This course does not only emphasize the aspect of understanding theory, but also practices related to tax calculations. So far, learning activities in taxation courses are more often carried out face-to-face using conventional learning media such as whiteboards, printed books, and worksheets. The learning methods used also involve lectures and discussions. The use of technology has not been optimally utilized in learning activities in this course. In fact, as we know today, the era of using digital technology in all fields including in learning activities currently requires an educator to be more creative and innovative in developing learning media to facilitate the learning process. Moreover, with the rise of distance learning (PJJ) which changes learning activities that are usually carried out face-to-face to virtual face-to-face, of course, it really needs tools in the form of the use of technology-based learning media.

One of the efforts that needs to be done is learning innovation in the form of utilizing media so that students have a complete understanding of the concept of the material. The limitations of real experiments can be overcome with other types of experiments that can be operated by each student, namely virtual experiments. Virtual experiments present virtual practicums operated by computers. One of the media that can be used in taxation lectures is by implementing a virtual laboratory. Virtual laboratories as learning media will make it easier for students to understand learning materials without having to practice directly because the practice process can be done virtually. This virtual laboratory can be used to help the learning process in order to improve students' understanding of the material (Sutrisno, 2011). Sony & Katkar (2014) said that a virtual laboratory is an interactive experience where students observe and manipulate objects, data, or phenomena produced by the system in order to meet learning objectives. The concept is interpreted as a meaning that has similarities to an object. People who understand a concept can make abstractions of other objects (Djamarah, 2011). A virtual laboratory is an interactive environment that is deliberately created to conduct experiments or experiments and simulations in a particular field of science or field of study (Albu et al., 2004).

A virtual laboratory is a system created to facilitate the implementation of practical activities that were previously carried out manually. The virtual laboratory is expected to be able to provide an opportunity for users, in this case students, to carry out practical work without having to be present in person in the laboratory room. A virtual laboratory is laboratory equipment that can be viewed virtually in the form of a computer program (software) operated by a computer. A virtual laboratory is a system that can be used to support a practical system that runs conventionally. This virtual laboratory is commonly referred to as a Virtual Laboratory or V-Lab which is a combination of the development of infor-

mation and communication technology with the theory of implementing practical work in a learning environment (Ramadhani et al., 2021). This virtual laboratory is expected to be able to provide an opportunity for students in particular to carry out practical work both through and without internet access so that students do not need to be present to take part in practical work in the laboratory room. This is able to realize effective learning because students can learn actively on their own without the help of instructors or assistants like the current system. The web-based display format is quite helpful for students to be able to take part in practical work independently (Puspita & Yamin, 2008).

According to Robeck as quoted by Arba'at (2008) in Virtual Learning, virtual learning provides many benefits: (a) applying skills in the science process (the use of science process skills); (b) scientific inquiry; (c) critical thinking; (d) conceptual understanding; and (e) understanding the nature of science. Carnivale stated "Learning on computer simulations can also be fun, in a virtual laboratory you can try anything you want, and that's okay". Learning on computer simulations can also be fun and in a virtual laboratory you can try anything you want, and that's okay. As for the virtual laboratory itself, it can be divided into two main types, namely laboratories based on simulators and laboratories based on real hardware equipment, both 2-D and 3-D. The first type is based on a set of software models that are objects or systems at a certain level of abstraction. Meanwhile, laboratory skills aim to improve students' psychomotor abilities. The success of developing the cognitive domain also has a positive impact on the development of the psychomotor domain. Psychomotor skills are all physical actions that are concrete and have been observed both in quality and quantity, because they are open. However, besides psychomotor skills, these skills cannot be separated from cognitive skills, these skills are also related to many affective skills. So,

The use of virtual laboratories in the teaching and learning process is based on David Kolb's (1984) experiential learning theory which is rooted in the constructivist approach and the work of John Dewey (Ouyang & Stanley, 2014). Around 1938, Dewey emphasized that learning cannot take place without practice and active participation of students. Kolb advocated and implemented Dewey's concept of "learning by doing," believing that learning occurs through cognitive and experiential learning (Kolb & Kolb, 2012). The core of experiential learning theory lies in the participation and experience of each student (Ouyang & Stanley, 2014). The application of virtual laboratories in teaching ensures active learning of students (Evans et al., 2004). The use of virtual laboratories allows students to experience direct feedback and interaction (Dyrberg et al., 2017; Tan & Waugh, 2013). Therefore, virtual laboratories help students learn through practice and become more engaged in their learning (Gallagher et al., 2005; Marchevsky et al., 2003).

Virtual laboratories are a transformative tool in science education, but comprehensive reviews of their prospects are limited. Ying Zhang (2024) research shows that virtual laboratories have demonstrated adaptability across a variety of disciplines, including chemistry, physics, biology, engineering, and medicine.

So far, the use of virtual laboratories has only been used as a medium for practice in exact science materials such as mathematics, physics, chemistry and biology, while for non-exact learning such as history, sociology, economics, and accounting, it has not been widely used. In fact, the application of this virtual laboratory media is very interesting if it can be applied to non-exact learning materials. This is supported by several previous research results that highlight virtual laboratories as an alternative to face-to-face tutorials and are an interesting new way to prepare for practice-based work (Makransky et al., 2016). Of course, this can make learning more effective because students can learn independent-

ly without having to receive guidance from instructors or assistants like the current practical activities. This statement is supported by the results of Manyilizu (2023) study which stated that students who first attended a virtual laboratory performed better in their skills compared to paper-based student experiences. The effectiveness of using virtual laboratories has also been shown to provide a good understanding of distance learning for measurement subjects in physics lessons which have so far been carried out through real laboratories (Azizah et al., 2022). So this virtual laboratory can be developed in a web-based display to make it easier for students to access and carry out practical learning independently (Puspita & Yamin, 2008).

The implementation of virtual accounting laboratories in learning is a necessity that must be realized immediately in order to meet the needs of students related to the implementation of taxation practicum learning activities. Therefore, by developing a virtual accounting laboratory for taxation practicums, it is hoped that learning activities can be more optimal even though they are carried out virtually (online). In line with this, several previous studies have been conducted regarding the effect of the effectiveness of virtual laboratories in learning, one of which is a study conducted by (Byukusenge et al., (2022) which states that laboratories are effective in improving conceptual understanding, practical skills, and student motivation and attitudes towards learning. The results of this study support previous research conducted by Ramadhan & Irwanto (2017) which also proved that virtual laboratories can improve problem solving, critical thinking, creativity, conceptual understanding, skills, motivation, interest, perception and learning outcomes in students. Most of the results of previous studies show that so far the development of virtual laboratories has only been carried out in exact or science courses such as chemistry, physics, and biology, while in social science courses such as economics, accounting, and taxation it has not been done much. Based on these problems, it is important to conduct research on the effectiveness of implementing virtual accounting laboratories in taxation courses which are a group of non-exact sciences on student learning outcomes.

METHODS

Research Design

This type of research is experimental research. There are several forms of experimental designs that can be used in research, namely: Pre-Experimental Design, True Experimental Design, Factorial Design, and Quasi Experimental Design (Sugiyono, 2013: 73). The research design used in this study is Quasi Experimental Design. This form of experimental design is a development of True Experimental Design which is difficult to implement. This design has a control group, but does not function fully to control external variables that affect the implementation of the experiment. In Quasi Experimental Design there are two forms of quasi-experimental designs, namely Time-Series Design and Nonequivalent Control Group Design (Sugiyono, 2013). The form of quasi-experimental design used in this study is Nonequivalent Control Group Design. This study was conducted to measure the level of effectiveness of learning using virtual laboratory learning media with learning without using virtual laboratory media in the taxation course on the topic of Article 21 Income Tax.

The population in this study were all students of the Accounting Study Program, Faculty of Economics and Business, State University of Malang (UM) who were taking the taxation practicum course. The selection of samples in this study was based on class or also called Cluster Sampling. Cluster sampling is a sampling technique based on existing classes or groups. The samples used in this study were two classes, namely the MM Offering and NN classes with 30 students each. The selection of the two classes, one class, namely the MM Offering class, was grouped into an experimental class and the other class, namely the NN Offering class, as a control class.

The research instruments used were the Syllabus and RPS (Semester Lecture Plan) of the taxation course to facilitate the design of learning activities. The next is the taxation practicum module which will later be used as learning material for the control class, namely in the form of a taxation practicum book along with printed worksheets which will later be worked on manually. Then the virtual laboratory media is a web hosting-based learning media that can be accessed online. The menu content in this virtual tax practicum laboratory includes teaching materials, video tutorials, and tax practicum worksheets. To measure the effectiveness of the two media, a test question sheet related to the PPh Article 21 material was used which was given before and after the learning was carried out in the control class and also the experimental class. The last is a student response questionnaire sheet to collect information about student responses to learning using virtual laboratory media. The questionnaire used in this study was a closed questionnaire in the form of a checklist and was used after the learning was carried out.

Data analysis

The data analysis techniques used include descriptive analysis todescribe the learning outcomes of students taught using virtual accounting laboratories and manual laboratories. Then to test the learning outcomes of students using statistics parametric, then the t-test is used. - This test requires passing the normality and homogeneity tests. If the data does not meet one or both of these prerequisites, then the Mann Whitney test is carried out. Hypothesis testing uses a two-tailed test (Two Tail Test). A two-tailed test is used if the null hypothesis (Ho) reads "equal to" and the alternative hypothesis (Ha) reads "not equal to" (Ho = ; Ha). In this study, the number of samples between the two classes, namely the control class and the experimental class, is not the same. After the t-test calculation is carried out, it is then compared with the t-table value. If we look at the calculated statistics (t count) with the table statistics (t table), then the conclusion drawn is determined by the rule that if t count> t table, then H0 is rejected and vice versa if t count <t table, then H0 is accepted. t table is obtained at a real level of 0.05 with degrees of freedom (dk) for various sample sizes and homogeneous variants, namely dk = n1 + n2 - 2. And to find out the student's response to the learning activities analyzed by percentageing the results of the student questionnaire answers with the formula P = F / N x 100%. Then the results of the student's responses can be categorized into the criteria Very weak for 0% - 20%, Weak for 21% - 40%, Sufficient for 41% - 60%, Strong for 61% - 80%, and Very strong for 81% - 100%.

RESULT AND DISCUSSION

The data collected are in the form of pre-test and post-test results for the control and experimental classes which will be given before and after the lecture activities which are used to determine the differences in student learning outcomes in the taxation practicum course taught using a virtual accounting laboratory and a manual accounting laboratory.

Referring to the decision-making criteria, if sig <0.05 then the data is normally distributed, and if sig > 0.05 then the data is not normally distributed. The test output shows a significant value (sig) for each data from the pre-test and post-test results for the experimental and control classes. The pre-test data for the experimental class shows a sig value of 0.007 for the Kolmogorov-Smirnov test and 0.151 for the Shapiro-Wilk test and it can be concluded that the data is not normally distributed. The post-test data for the experimental class shows a sig value of 0.001 for the Kolmogorov-Smirnov test and 0.000 for the Shapiro-Wilk test and it can be concluded that the data is normally distributed. The pre-test data for the control class shows a sig value of 0.129 for the Kolmogorov-Smirnov test and 0.151 for the Shapiro-Wilk test and it can be concluded that the data is not normally distributed. The post-test data of the control class showed a sig value of 0.000 for the Kolmogorov-Smirnov

test and 0.004 for the Shapiro-Wilk test and it can be concluded that the data is normally distributed. Considering that there is still data that is not normally distributed, further data analysis uses non-parametric statistics.

Table 1. Descriptive Analysis

	N	Min	Max	Mean	Std. Deviation
Pre-Test Experiment	25	30	90	62.40	14.224
Post-Test Experiment	25	70	100	85.60	12.275
Pre-Test Control	25	40	90	63.20	13.454
Control Post-Test	25	60	90	77.20	10.214
Valid N (listwise)	25				

Source: Processed primary data (2024)

Table 2. Normality Test

	Class	Kolmogorov-Smirnova			Shapiro Wilk		
		Statistics	df	Sig.	Statistics	df	Sig.
Student Learning Outcomes	Experimental Pre-Test (Virtual Lab)	.207	25	.007	.940	25	.151
	Experimental Post-Test (Virtual Lab)	.240	25	.001	.811	25	.000
	Control Pre-Test (Lab Manual)	.154	25	.129	.940	25	.151
	Post-Test Control (Lab Manual)	.248	25	.000	.866	25	.004

a. Lilliefors Significance Correction

Source: Processed primary data (2024)

Table 3. Wilcoxon Test Results

		N	Mean Rank	Sum of Ranks
Post-Test Experiment - Pre-Test Experiment	Negative Ranks	0a	.00	.00
	Positive Ranks	22b	11.50	253.00
	Ties	3c		
	Total	25		
Post-Test Control - Pre-Test Control	Negative Ranks	1d	5.00	5.00
	Positive Ranks	20e	11.30	226.00
	Ties	4f		
	Total	25		

a. Post-Test Experiment < Pre-Test Experiment

b. Post-Test Experiment > Pre-Test Experiment

c. Post-Test Experiment = Pre-Test Experiment

d. Post-Test Control < Pre-Test Control

e. Post-Test Control > Pre-Test Control

f. Post-Test Control = Pre-Test Control

Source: Processed primary data (2024)

Based on the results of the data normality test, it is known that the data is not normally distributed, so to determine the effect of the use of virtual accounting laboratories on student learning outcomes in the taxation course, the PPh Article 21 course was analyzed using non-parametric Wilcoxon test statistics by comparing the average of the experimental class that applies virtual laboratories for learning and also the control class that uses manual laboratories. Based on the SPSS version 25 output above, the results show that the experimental class shows a negative ranking of 0a, which means that no students experienced a decrease in value from the pre-test to the post-test, a positive ranking of 22b, which means that 22 students experienced an increase in value from the pre-test to the post-test, and ties 3c, which means that 3 students did not experience a change in value from the pre-test to the post-test. Then in the control class, it shows a negative ranking of 1a, which means that there is one student whose value decreased from the pre-test to the post-test, a positive ranking of 20b, which means that 20 students experienced an increase in value from pre-test to post-test, and ties 4c , which means that 4 students did not experience any change in their scores from pre-test to post-test.

Table 4. Wilcoxon Test Results

	Post-Test Experiment - Pre-Test Experiment	Post-Test Control – Pre-Test Control
Z	-4.139b	-3.913b
Asymp. Sig. (2-tailed)	.000	.000
a. Wilcoxon Signed Ranks Test		
b. Based on negative ranks.		

Source: Processed primary data (2024)

Based on the second output result, Asymp. Sig. (2-tailed) is obtained as 0.000 which means it is smaller than <0.05, so the hypothesis is accepted, which means that there is an influence of the use of virtual accounting laboratories on student learning outcomes in the taxation course, PPh Article 21 course.

Based on the SPSS 25 output, it shows a significance value (Sig) Based on the Mean of 0.109> 0.05 so that it can be concluded that the variance of the post-test data of the experimental class and the control class is the same or homogeneous. However, because the main requirement, namely data normality, is not met, further testing still uses non-parametric.

Table 5. Homogeneity Test

		Levene Statistics	df1	df2	Sig
Student Learning Outcomes	Based on Mean	2.664	1	48	.109
	Based on Median	1.210	1	48	.277
	Based on Median and with adjusted df	1.210	1	47.314	.277
	Based on trimmed mean	2.710	1	48	.106

Source: Processed primary data (2024)

Table 6. Mann Whitney Test

	Class	N	Average Rating	Number of Ratings
Student Learning Outcomes	Post-Exam Experimental Class (Virtual Lab)	25	30.24	Rp 756,000.00
	Post-Exam Control Class (Lab Manual)	25	20.76	519.00
	Total	50		

Source: Processed primary data (2024)

Mann-Whitney was used to determine whether there was a difference in the average between the post-test data for the experimental class and the control class. Based on the SPSS version 25 output above, it shows a significant value (Asymp. Sig. (2-tailed)) of 0.018, which is smaller than > 0.05.

T**abel 7**. Mann Whitney Test

Student Learning Outcomes	
Mann-Whitney University	194.000
Wilcoxon W	519.000
English: Z	-2.367 years
Asymptomatic Sig. (2-tailed)	.018
a. Variable Grouping: Class	

Source: Processed primary data (2024)

With the test criteria Asymp. Sig. (2-tailed) < 0.05; then the hypothesis is accepted and Asymp. Sig. (2-tailed) > 0.05; then the hypothesis is rejected. The results of the hypothesis test show an asymp sig value of 0.018 which is smaller than 0.05, so the hypothesis is accepted, thus there is a significant difference between the post-test results of the experimental class and the control class.

Differences in Student Learning Outcomes Through the Utilization of Manual Laboratories and Virtual Accounting Laboratories

The control class in this study were students who were taught without using a virtual accounting laboratory. Lecture activities in this class were carried out using a manual laboratory, namely by working on taxation practicum cases using a practicum book. Before starting the lecture activities, students were first given a pre-test as an initial test, then after completing the lecture without using a virtual laboratory, a final test (post-test) was given to determine their level of understanding of the material on Income Tax Article 21. The learning achievement of students in the control class or those taught without using a virtual laboratory for the taxation course on the subject of Income Tax Article 21, obtained an average pre-test score of 63.20 while the average post-test score was 77.20.

The experimental class in this study were students who were taught using a virtual laboratory for taxation courses on the subject of Income Tax Article 21. Before starting the lecture activities, students were first given a pre-test as an initial test, then after completing the lecture using the virtual laboratory, a final test (post-test) was given to determine their level of understanding of the material on Income Tax Article 21. The learning achievement of students in the experimental class or students who were taught using a virtual accounting laboratory showed an average pre-test score of 62.40 while the average post-test score was 85.60. Based on these results, it can be seen that the increase in the average pre-test and post-test scores of the experimental class was higher than that of the control class. Students who were taught using a virtual accounting laboratory on the subject of Income Tax Article 21 experienced a significant increase in scores when compared to students who were taught using a manual laboratory.

The results of this study are in accordance with previous studies which prove that there are differences in student learning outcomes in real and virtual laboratories using the guided inquiry learning model (Endang Rizkiana et al., 2018).

In addition, the results of Castro research (2025) show that the effect of using virtual laboratories is very large on academic achievement.

This shows that the use of virtual accounting laboratories in the PPh Article 21 taxation practicum material can be said to be effective because it has been proven to be able to improve student learning outcomes.

Based on the results of the Wilcoxon Test showing Asymp. Sig. (2-tailed) of 0.000 which means less than <0.05 then the hypothesis is accepted which means there is an effect of the use of virtual accounting laboratories on student learning outcomes in the taxation course on the subject of Income Tax Article 21. This is further strengthened by the results

of the Mann-Whitney statistical test which shows a significant value (Asymp. Sig. (2-tailed)) of 0.018 which means less than 0.05 then the hypothesis is accepted so it can be concluded that there is a significant difference between the post-test results of the experimental class and the control class.

The results of the study prove that classes taught using virtual accounting laboratories have a higher average post-test value when compared to classes taught without using virtual laboratories in the taxation course of Income Tax Article 21. So it can be concluded that the use of virtual laboratories can be said to be effective because it has been proven to be able to improve student learning outcomes. This is reinforced by the results of student responses after attending taxation lectures using virtual laboratories, where 97.8% stated that they preferred using virtual accounting laboratory media in taxation practicum learning in the PPh Article 21 course because it was easier and faster to work on the given practical questions.

In addition, the results of the response questionnaire also showed that students better understand and are able to work on taxation practicums on Article 21 Income Tax material using a virtual laboratory. This is because the virtual laboratory is designed and developed using an information technology-based system and using a website so that it can be accessed online and later students only need to enter data related to taxpayer income then the data entered will be processed automatically up to the calculation of Article 21 Income Tax that must be deducted up to the reporting of Article 21 Income Tax deductions monthly to annually so that it can be said to be more effective for use in working on taxation practicum cases regarding Article 21 Income Tax material.

The results of this study are also supported by Manyilizu research (2023) which states that virtual laboratories are a very useful tool for practical learning, both for universities that have real laboratories and those that do not. Virtual laboratories have also been proven to be able to improve students' literacy and problem-solving skills through the Problem Based Learning model (Supahar & Widodo, 2021). Nugroho (2021) adding that virtual labs allow students to experience active learning with a neatly organized learning flow. Meanwhile Ramadhan & Irwanto (2017) also explained that virtual laboratories have the ability to improve problem-solving skills, critical thinking, creativity, conceptual understanding, scientific processing skills, practical skills, and students' motivation, abilities, interests, perceptions, and learning outcomes. Furthermore, Fadli (2024) also found that Project-Based Learning-Based Virtual Laboratories can be an effective tool to support constructivist learning. The results of another study by Byukusenge (2022) explained that virtual laboratories are effective because they improve students' conceptual understanding, laboratory or practical skills, and motivation and attitudes.

Interactive and flexible online learning has the potential to provide students with deeper conceptual understanding. Virtual experiments provide flexible learning opportunities that can overcome the barriers of time, pace, and place for learners from the community (Hamed & Aljanazrah, 2020).

Therefore, educators must utilize virtual laboratories to improve the quality of teaching and student learning outcomes. Based on the results of the research and discussion above, it can be concluded that the use of virtual laboratories in taxation lectures on the Income Tax Article 21 course can be said to be effective in improving student understanding and learning outcomes.

CONCLUSION

Based on the results of the study and discussion, it can be concluded that the learning outcomes of students in classes that use virtual accounting laboratories have increased higher when compared to classes that do not use virtual accounting laboratories. In addition, there are also differences in the learning

outcomes of classes taught using virtual accounting laboratories with classes taught without using virtual accounting laboratories. And there is an effect of the use of virtual accounting laboratories on student learning outcomes in taxation courses on the subject of Income Tax Article 21. Important findings in this research also prove that the use of virtual laboratories on non-exact scientific material such as taxation can also improve learning outcomes. The suggestions that can be given are that virtual accounting laboratories can be further developed and used for other materials with the hope of increasing students' understanding of all accounting materials, the use of virtual accounting laboratories can be socialized and disseminated with the hope that they can be used by lecturers at other universities as a technology-based learning media for accounting learning. Further researchers should be able to develop this virtual accounting laboratory media for accounting and taxation learning on other topics or courses and can use different courses including being applied to learning for high school or vocational school students.

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