Effectiveness of simulation-based learning using "e-archive" technology in the archiving subject vocational school

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ABSTRACT

This study aimed to assess the effectiveness of the simulation-based learning model using "e-archive" technology in the archiving subject in the vocational school of management program. A randomized pretest-posttest control group design and 144 students from Central Java, Indonesia were employed in this quasi-experimental study. The data were analyzed by using the independent sample t-test to determine whether there was a significant mean difference between the experimental class and the control class. The results of this study indicated that the experimental class with the simulation-based learning model using e-archive technology gets better scores than the control class using the conventional learning model. The pretest t-test results in a score of 0.139, while the posttest results in a score of 0.000. We concluded that the simulation-based learning model using e-archive technology is effective and suitable for use in vocational schools, with implications for enhancing student learning results.

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1. INTRODUCTION

Indonesian vocational schools have an objective in which of preparing their graduates to be accepted by the industry based on their expertise. Graduates prepared for industry needs must possess advanced practical and technical skills [1]. Creating an outstanding student of his or her expertise needs a lot of practical activities that are appropriate to the industry [2]–[4]. Even the application of realistic situations in learning is considered essential in the development of certain complex and technical skills [5]. For this reason, learning in vocational schools requires activities that can simulate working conditions. However, it is important to understand that when applied to students, it is necessary to have assistance from the teacher using systematic guidance in order to obtain maximum results [6]. The simulation-based learning model is a systematic model that offers to learn with a practical approach through the adoption of the real world (the reality of work) from a particular event or situation with the aim of facilitating a deeper understanding related to further investigation, problem-solving, and decision making [7]–[9] at the vocational, management, and teacher levels. In the systematic process, students were asked to imitate the reality of work by interacting with technology, objects, or authentic devices [10]–[12].

In the simulation model, teachers and students are given the opportunity to change and adjust the realities of work by facilitating exercises such as acting as an archivist who carries out the archive management process using an e-archive application. By playing this role, students have the opportunity to project themselves into the situation they will face and stimulate them with various existing problems in that situation. The e-archive is an application program that has been developed by the authors in the previous study which is used in building the concept and implementation of simulation-based learning. This confirms the position of e-archive as a medium used in the simulation process and becomes the main catalyst for measuring the effectiveness of archival learning in vocational schools. The primary focus of this study is on observations to determine the effectiveness of the simulation-based learning model using e-archive technology in the archiving subject at the vocational high school of management program and office automation. In addition, the researchers intend to see comprehensively how the use of models and technology can affect student learning outcomes in archival competence. Besides, archiving basic competence is one of the important competencies that must be possessed by archivist employees and practitioners, who will be involved in the archival industry [7].

These competencies include the skills to create, receive, store, distribute, and maintain records. On the other hand, archival learning problems [13] include: i) The scope of archival material that has not yet been developed; ii) The limited archival teaching materials; iii) Teachers who have not applied the right model to teach archival material; and iv) Practical learning facilities that are limited. Therefore, this study is required to find out how to provide effective archival learning to students in order for them to obtain archival competence in accordance with industry needs. In this study, archiving learning is carried out using a simulation-based learning model of e-archive technology. The e-archive technology in question is a technological device or realistic object that is used as a digital learning media and simulation tool. Digital learning is carried out using the principles of freedom, independence, flexibility, compatibility, suitability, mobility, and efficiency so that the media used can support the achievement of predetermined learning objectives [8]. Based on the presented data and evidence, the researchers dig deeper by testing archiving learning using a simulation-based learning model, and whether the learning media is effectively used to improve the ability of vocational school students in supporting their work readiness. In addition, this study can be used as a reference in conducting archival learning for vocational school students who want to achieve competencies according to their needs.

2. RESEARCH METHOD

2.1. Participants and research data

This study used a randomized pretest-posttest control group design as quasi-experimental research. It was conducted in a social study to compare the control and the experimental groups [11], [14]. A pretest-posttest control group design was used in this study [12], [14]. The effectiveness test was carried out before being given treatment (pretest) and after being given treatment (posttest), then compared with the conditions before and after treatment. The experimental design in this study is shown in Figure 1 [13], [15].

	Pretest	Treatment	Posttest
Experimental group	O1	X1	O2
Control group	O1	X2	O2

Figure 1. Pretest-posttest control group design

The selection of research subjects was done randomly and each research subject had the same opportunity and treatment according to the specified group. The pretest-posttest assessment instruments were used in this study to measure students' learning outcomes, especially their cognitive aspects. The assessment instrument has 20 questions that cover every chapter of the archiving subject. This study was conducted from July 2021 to February 2022 in Central Java, Indonesia by involving 144 students of the vocational high school of and management program and office automation in archiving subject, Surakarta City, Central Java, Indonesia. The 10th grade students of vocational high school of office automation and management program were involved in this study. The control class in this study was 36 students from State Vocational High School 6 Surakarta and while the experimental class was 36 students from State Vocational High School 1 Surakarta. Each class was taught by the same teacher. The experimental class received a simulation-based learning model treatment using e-archive technology, while the control class did not.

2.2. Instrument-test analysis

The instrument test was carried out to measure the level of student understanding demonstrated by the basic abilities or student learning outcomes. The test was given to determine the level of students' cognitive abilities. Students studied the material using a e-archive simulation-based learning model before taking the test, either in groups or individually. This study's instrument-test analysis evaluated the questions' validity, reliability, level of difficulty, and discriminating power.

The validity of the items was tested using the Product Moment Correlation formula using the raw score, $r_{xy} = \frac{N\sum XY-(\sum X)(\sum Y)}{\sqrt{(N\sum X^2-(\sum X)^2)(N\sum Y^2-(\sum Y)^2)}}$, and correlation coefficient (validity) using t-test, $t = \frac{r\sqrt{n-2}}{1-r^2}$. As for each symbol in the formula: r_{xy} is the item-total correlation coefficient; X is the item score; Y is the total score; and N is the number of subjects. This validity test has criteria that can be categorized into certain levels. These levels indicate the quality of the validity data. Table 1 shows the criteria for the validity of the item validity coefficients.

Table 1. Criteria for item validity coefficients

Validity coefficient	Interpretation
0.80<r≤1.00	Very high
0.60<r ≤0.79	High
0.40<r≤0.59	Middle
0.20<r≤0.39	Low
r≤0.20	Very low

Using the formula, the validity test of the questions is determined: when the t-count exceeds the t-table, the question is declared valid. In addition, to find out the t-score, we must know the following symbols: t is the t-count value; r is the correlation coefficient of the r-calculated result; n is the number of respondents. The reliability of the questions was tested using the Spearman-Brown formula (Split Half), $r_1 = \frac{2\,r_b}{(1+r_b)}$ and second (odd-even).

The decision-making of each symbol in the formula is: r1 is the reliability value of all questions and rb is the correlation product moment between the first number. Reliability is a prerequisite test required in quantitative analysis. This reliability test shows the extent to which a measuring instrument can be trusted and relied on. The level of reliability is shown on a scale of 0-1. The reliability of the question is determined by the value of the reliability coefficient classification as seen in Table 2.

Table 2. Reliability coefficient classification

Interval	Reliability
r≤0.20	Very low
0.20<r≤0.40	Low
0.40<r≤0.60	Middle
0.60<r≤0.80	High
0.80<r≤1.00	Very high

The item difficulty index (DI) is tested using the formula, $DI = \frac{CN_U + CN_L}{S_U + S_L}$. Each symbol in the formula is: i) Difficulty Index (DI) is the index of difficulty; ii) Correct Number Upper group (CNU) is the correct number of each item in the upper group; iii) Correct Number Lower group (CNL) is the correct number of each item in the lower group; iv) Student Upper group (SU) is the number of students in each upper group; v) Student Lower group (SL) is the number of students in each lower group. The difficulty level index is used to determine the extent to which the developed questions meet certain difficulty criteria according to the research objectives. Table 3 shows the criteria for the item difficulty index.

The discrimination index of the items is tested using the formula, $DisI = \frac{CN_U - CN_L}{C_U\ X\ Max}$. Each symbol in the formula is: i) DisI is the discrimination index; ii) CNU is the correct number for the upper group; iii) CNL is the correct number for the lower group; iv) SU is the number of students in the upper group; v) SL is the number of students the lower group; and vi) Max is the maximum score for each item. This discriminatory index criterion is divided into several levels which indicate the statistical value of the discriminatory data value. The criteria for discrimination index can be seen in the Table 4.

The questions that have been made must meet all prerequisite tests before being used to test the increase in students' abilities following the treatment. The questions are practical and can be utilized as test instruments in this study once they have fulfilled the standards for validity, reliability, level of difficulty, and discriminating power. Based on this, questions can be used as valid and reliable instruments. Then, the analysis can proceed to the next stage.

Table 3. Criteria for item difficulty index

Difficulty index	Interpretation
DI=0.00	Too difficult
0.00<DI≤0.30	Difficult
0.30<DI≤0.70	Middle
0.70<DI≤1.00	Easy
DI=1.00	Too easy

Table 4. Criteria for discrimination index

Discrimination index	Interpretation
DisI≤0.00	Very bad
0.00<DisI≤0.20	Bad
0.20<DisI≤0.40	Enough
0.40<DisI≤0.70	Good
0.70 <DisI≤1.00	Very good

3. RESULTS AND DISCUSSION
3.1. Results

Inferential statistical analysis was used throughout the testing phase to determine whether the simulation-based learning model using e-archive technology was effective. This statistic will be suitable if the sample is taken from a specific population, and the sampling technique from the population is done randomly [16]. An experimental class was exposed to a simulation-based learning model employing e-archive technology while a control class was not. This was done to investigate the effectiveness of learning media in enhancing student learning outcomes. Effectiveness is seen based on inferential statistical analysis which is preceded by prerequisite tests, namely normality and homogeneity tests.

The normality test was used to determine whether the sample used in this study came from a normally distributed population or not [17]. The test was done using the formula of Kolmogorov Smirnov. The homogeneity test was conducted to determine whether the variances came from the same number of populations or not [17]. The homogeneity test was done using the formula of Levene. The effectiveness of learning media in enhancing learning outcomes is analyzed using paired sample t-test parametric statistics if the conditions for data normality are met (data are normally distributed). If it is not normal, then a non-parametric statistical test of two related samples (Wilcoxon) is used. Both analyzes for the prerequisite test were performed using SPSS statistical analysis software.

After completing the two necessary assessments, the t-test was used to analyze the student learning outcomes, specifically the cognitive component, that were obtained by the experimental class and control class. This t-test is intended to test the mean difference significantly between the experimental class and the control class after being given treatment. The provisions in this hypothesis test use the Independent Sample t-test with a significance level of 0.05, or 5%. After determining the significance level, it is possible to determine whether the experimental class has better learning outcomes than the control class. This test was performed using SPSS statistical analysis software.

A randomized pretest-posttest control group design and the pretest were used to evaluate the effectiveness of the simulation-based learning model using e-archive technology. The posttest instruments used were tested for validity, reliability, level of difficulty, and discriminating power of questions. There are 20 questions in the pretest and posttest that have passed the validity, reliability, level of difficulty, and discriminatory questions. The pretest and post-test activities were used to determine the difference in conditions before and after an experimental treatment was carried out in certain classes. Pretest and posttest were administered in this study to the experimental class and the control class in accordance with the study's objectives. Table 5 shows the outcomes of the pretest-posttest of the experimental class and the control class.

Table 5. Average pretest and posttest scores of experiment class and control class

No.	Schools	Experiment class		Control class	
		Pretest	Posttest	Pretest	Posttest
1	SMK N 1 Surakarta	67.91	81.38	68.88	70.13
2	SMK N 6 Surakarta	62.50	80.13	66.25	70.55
	Average	65.20	80.76	67.56	70.34

SMKN=State vocational high school

Based on the table, it is clear that the experimental class's average pretest score for student learning outcomes was 65.20, whereas the posttest score rose significantly to 80.76. On the other hand, the average pretest value of the control class was 67.56 and experienced a slight increase in the posttest value of 70.34.

The simulation-based learning model using e-archive technology can be seen to have a significant impact on student learning outcomes based on the average score. Before running the t-test on the student score data, prerequisite analysis, normality test, and homogeneity test need to be run in order to learn more about the effects on students in the experimental class and control class. The results of the prerequisite test, normality test, Kolmogorov Smirnov test, show that the pretest significance value in the experimental class is 0.190, and in the control class is 0.200. Meanwhile, the posttest significance value in the experimental class is 0.080, and in the control class is 0.200. The cognitive value data from the pretest and posttest for the experimental class and the control class were therefore determined to be normally distributed.

In addition, the results of the homogeneity test, Levene's test, show that the significance value of Levene's Test for the pretest results is 0.408 and 0.805 for the posttest, so it can be concluded that the pretest and posttest cognitive values between the experimental class and the control class have homogeneous variance. After knowing the results of the prerequisite test for the analysis of students' pretest and posttest scores, the effectiveness test using the t-test can be carried out. The results of the students' t-test pretest showed that there was no significant difference in the average student learning outcomes between the experimental and the control classes which can be seen from the results of the significance test of 0.139, or greater than 0.005. Independent sample t-test is a parametric test used in formulating the difference in the mean between two groups that are not a couple or influence each other and aims to ensure that the two groups are different. The Independent sample t-test results are shown in Table 6.

Table 6. T-test (independent samples test) pretest experiment and control classes

		Levene's test for equality of variances		t-test for equality of means						
		F	Sig.	T	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference Lower	Upper
Pretest	Equal variances assumed	0.689	0.408	-1.488	142	0.139	-2.36111	1.58679	-5.49790	0.77567
	Equal variances not assumed			-1.488	137.709	0.139	-2.36111	1.58679	-5.49874	0.77651

The results of the students' t-test posttest revealed that there was a significant difference in the average student learning outcomes between the experimental and the control classes. It can be seen from the significance test which showed a value of 0.000, or less than 0.005. These results indicate that the learning outcomes of the experimental class students are better to those of the control class. Independent sample t-test testing is also required for post-test activities. This needs to be done, apart from being a differentiator between the two groups of data, it can also be used to determine the level of difference between the pretest activities. Table 7 provides further information regarding the t-test posttest results. According to the results of the t-test, it can be concluded that learning with a simulation-based learning model using e-archive technology is effective in improving student learning outcomes in vocational school management programs.

Table 7. T-test (independent samples test) posttest experiment and control classes

		Levene's test for equality of variances		t-test for equality of means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean difference	Std. error difference	95% confidence interval of the difference Lower	Upper
Posttest	Equal variances assumed	0.061	0.805	8.572	142	0.000	10.41667	1.21523	8.01439	12.81894
	Equal variances not assumed			8.572	141.635	0.000	10.41667	1.21523	8.01434	12.81900

3.2. Discussion

According to the results of the study, the experimental class's average pretest score was 65.208, whereas the control class average pretest score was 67.569. The significance value of the t-test for the pretest value of the two classes is 0.139, where the value is greater than 0.050. It shows that the learning outcomes for students in the experimental and control classrooms are not significantly different. These results suggest that the experimental class students' skills were comparable to those of the control class students at the beginning of the study. In addition, after giving different treatments to the experimental and control classes, the average posttest score for the experimental class was 80.76, while the posttest average score for the control class was 70.34. Furthermore, the significance value of the t-test in the posttest value of the two classes is 0.000, where the significance value is less than 0.050. It shows that the experimental and control classes' student learning outcomes differ significantly from one another. This reveals that the experimental class outperformed the control class in terms of student learning outcomes. The significant value suggests that students in the experimental class are more capable than those in the control class.

According to the study's design, the results of increasing archival learning outcomes before and after treatment show that the media simulation-based learning model using e-archive technology is effective in enhancing student learning outcomes. This phenomenon is also supported by several researches [18]–[30] where digital learning media can improve students' knowledge, and skills. Other research also states that digital learning media adapted to technological developments [31]–[34] and industry have a positive impact on students' work readiness [35]–[40]. This is imposed by the need for learning by utilizing information technology which is very much needed by teachers and students in achieving learning goals [41]–[44], as well as increasing student interest in learning [45]–[48].

The novelty that can be implied by the results of this study is that the e-archive media has been successfully developed and empirically proven to be able to provide the effectiveness of archival learning, particularly in improving the learning outcomes of vocational school students. The e-archive is not only applied to archival learning but also to simulation-based learning. Through simulation-based learning, the use of e-archive is more optimal because it is in accordance with the basic design of this media. The results of this study also provide more options for improving learning activities in optimizing learning outcomes in archival learning for students in vocational schools. As can be seen from this description, using the simulation-based learning model and e-archive technology is essential to enhancing student learning outcomes during the learning process. It is because educational media, particularly in the learning process, is one of the most supporting tools for the advancement of science. In order for the learning process to take place in the classroom efficiently, it is desired that the school will pay attention and provide comprehensive educational media. This is due to the fact that lessons that are taught using real-world examples encourage students to learn more. Lessons are also simpler to comprehend so that students can respond to questions on daily quizzes and final exams.

4. CONCLUSION

Based on the findings, this study shows that students who use the simulation-based learning model using e-archive technology obtain better grades than those who use conventional media. The increase in the average value of learning outcomes in the archiving subject pretest and posttest simulation-based learning models using e-archive technology shows that it significantly improves student learning outcomes. The use of the simulation-based learning model with e-archive technology has succeeded in improving student learning outcomes with a significance value of 0.000 or less than 0.050, and the average value of the experimental class is 80.76 while the control class is 70.34.

This study concluded that the simulation-based learning model using e-archive technology is effective and can be applied in vocational schools, with implications for improving student learning outcomes. The purpose of this study was to measure the effectiveness of archival learning using simulation-based learning and the use of e-archive media. The authors hope that the results of this study can be a reference for the development of research on archival learning that utilizes certain learning models and media. Empirical results demonstrating that simulation-based learning and e-archive media are able to improve student learning outcomes can be a research trend that can be developed in the future. The use of learning models in collaboration with special digital media created for specific subject characteristics can be a theme for future research on archival subjects in vocational schools.

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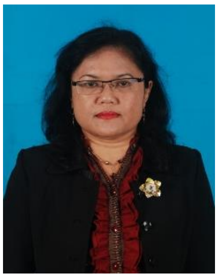

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