Journal of Humanities and Social Sciences Studies
ISSN: 2663-7197
DOI: 10.32996/jhsss
Journal Homepage: www.al-kindipublisher.com/index.php/jhsss

JHSSS
AL-KINDI CENTER FOR RESEARCH AND DEVELOPMENT

| RESEARCH ARTICLE

Management and Use of Multimedia as an ICT-Based Learning Media to Improve the Skills of Vocational School Students

Roemintoyo[1] ✉ and Hilmawan Wibawanto[2]
[12]Faculty of Teacher Training and Education, Sebelas Maret University, Surakarta, Indonesia
Corresponding Author: Roemintoyo, **E-mail**: roemintoyo@staff.uns.ac.id

| ABSTRACT
Vocational secondary education is a level of education that is closely related to mastery of skills. Through the learning process that has been going on so far, it seems that it is not optimal for students to master various skills that are important to master in the 21st century, especially for the learning outcomes of land surveying. The application of learning methods that are integrated with the use of digital learning media is expected to create a more active and student-centered learning environment. This study has a goal that focuses on seeing the effect of interactive ICT-based multimedia products on student skill achievement. This research method is an experimental method with a quasi-experimental design with pre and posttest in the control class and the experimental class. The data collection instrument used is questions. The population of this research is SMK students, with a total sample of 136 students selected by cluster sampling. The results of the study show that the use of interactive multimedia has a significant effect and is followed by an increase in student skill achievement. This study concludes that interactive multimedia is considered quite effective in influencing and improving students' skills as an effort to achieve learning goals and mastery of 21st century skills.

| KEYWORDS

Multimedia, Vocational School, Skills, Interactive

| ARTICLE INFORMATION

ACCEPTED: 20 January 2023 **PUBLISHED:** 01 February 2023 **DOI:** 10.32996/jhsss.2023.5.2.1

1. Introduction

Educational Technology is defined as "the study and ethical application of theory, research, and best practices to advance knowledge as well as mediate and improve learning and performance through the strategic design, management and implementation of learning and instructional processes and resources (AECT, 2022)." This definition states that educational technology has the main objective of solving learning problems or facilitating learning so that it is effective, efficient, interesting, and can increase the effectiveness of learning. One way to improve learning is to develop and utilize innovative and creative technology. In this context, a teacher as a learning facilitator must make students achieve competencies according to industry needs. Teachers are required to master skills, and the ability to adapt to new technology (Muizzuddin, 2019). Innovation and variations in the use of learning methods can be a solution to answer the challenges of the world of education, starting from elementary school, junior high school, senior high school, and vocational high school (Saripudin, 2017).

Vocational High Schools (SMK) comprehensively utilize and link technology, practical skills, attitudes, and life skills. This statement is in line with Walter's opinion Walter (Kuswana, 2013), vocational education is an educational program that prepares students to be ready to face the world of work. The importance of vocational education clearly emphasizes the development of student expertise, whether in the form of skills, knowledge or attitudes (Maryanti & Apriana, 2019). In essence, students are required to have the expected skills or competencies according to the needs of the world of work (Efendi et al., 2017). In the implementation of learning, a teacher must be able to guide students to achieve competencies that are in accordance with industry needs.

Educational technology in Indonesia has the potential to develop rapidly during the Covid-19 pandemic. The government's efforts to suppress the spread of the virus have forced learning activities in around 530,000 schools in Indonesia to use distance learning (Cahya, 2020). This distance learning is a direct appeal from the Ministry of Education, Culture, Research and Technology as an emergency policy for the spread of Covid-19 through Circular Letter Number 4 of 2020 concerning the implementation of Education policies during an emergency spread of Covid-19 (Menteri Pendidikan, 2020). Thus, many technology services for providing access to distance education continue to develop with start-ups that execute educational technology strategies quite well. In addition to technology services, teachers as an important element of learning must be able to prepare and apply learning strategies that can increase students' concentration and learning engagement with online learning (Fuady et al., 2021). A teacher must also be able to implement creative learning that provides quality online learning experiences to students (Nichols Hess & Greer, 2016; Mahmood, 2021). Distance or online learning is one of the solutions for implementing learning during the Covid-19 pandemic.

Online learning has been implemented since the beginning of the 2020 pandemic until now, encouraging the potential for developing technological innovations in learning. Furthermore, technological innovation in the form of digital media for learning facilitates the distance learning process (Mulenga & Marbán, 2020; Thomas & Rogers, 2020). On the negative side, students face many problems with internet access because they have to share gadgets with other family members (Bergdahl & Nouri, 2021). Students find it difficult to use video conferencing every day. Another negative impact on learning that requires laboratory space is difficult to do (Akliyah, 2021). Learning technologies, such as augmented reality or virtual laboratories for certain subjects need to be developed so that students still get the expected competencies (Muñoz-Saavedra et al., 2020; Godoy Jr., 2020). These negative impacts need to be intervened and efforts must be made to improve learning because there is no definite time when the Covid-19 pandemic will end.

Schools should think about and plan for remote learning solutions. On the other hand, a variety of learning methods is also a solution to this challenge. Some subjects may require a little movement and physical contact, such as subjects in vocational high schools. Vocational High School students must be taught psychomotor learning, not theory because they must be ready to face the world of work. These interventions or solutions can also be taken into consideration for the development of post-Covid-19 learning technology.

In fact, this problem also occurs in the world of vocational education in Indonesia. The negative impact of learning during the pandemic was felt during distance learning at Vocational Schools. Based on initial observations using a questionnaire on 1 – 5 December 2020, which discussed online learning activities during the Covid-19 pandemic. The questionnaire was filled out by 52 students of the Vocational School of Building Modeling and Information Design (DPIB) competency skills in the city of Surakarta. The questionnaire questions are devoted to the basics of building construction and land surveying techniques. The selection of these subjects is based on the problem of the difficulty of implementing practical learning online. Based on the results of the questionnaire on the practical implementation of land surveying techniques, according to the majority of respondents, it was not carried out. Although some respondents stated that practicums were still held, most likely respondents assumed that practicums were carried out using other methods, not practicum using special equipment. This statement is based on one of the characteristics of the practicum, namely, carrying out a procedure or activity in solving problems using the help of practical tools. The implementation of studying land surveying techniques is filled with the provision of material sourced from the internet, discussion in chat media, provision of learning videos, and using video conferencing. Some of these alternatives can indeed be a solution at the start of the pandemic, but other media are needed that can make students play an active role so they can carry out practicums. Then in the results of the next questionnaire, the majority of students have the motivation to carry out learning, but not a few are lacking, even have no motivation. It is possible that this is due to the lack of variation used by teachers in teaching. In terms of understanding the material in the fourth chart, only a few students felt they had mastered the material. The majority of students feel it is enough to understand the basic material. Even though the mastery of the material by the majority of students was quite good, there were still students who felt they were lacking. Some even did not master the material. Based on the results of the online learning activity questionnaire, distance learning policies make students less able to understand the material because the learning methods apply only study material and assignments online. As a result, student learning outcomes are not maximized and do not meet the KKM because students do not understand the material without practice. Practicum activities that are not carried out also indicate that students are not facilitated with digital learning media as a substitute for practicum equipment. This can also be interpreted that students do not have other supporting tools to study outside of school time to improve basic practicum skills. Therefore, one strategy in learning that can improve skills is by collaborating practicum activities with learning media.

Learning media that can be used by teachers to enrich learning in class, namely: audio narration, illustrations or pictures, video or animation, or a combination of all the media is called learning multimedia. Multimedia is capable of displaying complex material with interactive designs, such as the use of graphical data, animations, and experimental simulations (Lin et al., 2019; So et al., 2019). If it is associated with the problem of online practicum learning, the type of multimedia that can be a suitable solution is

simulation type multimedia. Simulation multimedia can provide an imitation or representation of environmental reality in multimedia. These types of multimedia can be suitable alternative solutions for practicum subjects, which directly practice procedures in carrying out work such as land surveying (Kareem, 2018; Lubis et al., 2021). The multimedia used can also make students who have playing experience more focused on solving learning problems (Saputri et al., 2018). Meanwhile, students who are less focused need to be given guidance regarding media and learning concepts. Based on evidence from several applications of learning multimedia, the effectiveness of multimedia in various subject subjects can be an alternative solution to improve students' practical skills (Nugraha & Wahyono, 2019; Kao & Luo, 2020).

In this study, a problem was found, namely, the teacher's lack of maximum use of learning methods, so that learning felt by students became boring and reduced student learning outcomes. Vocational High School (SMK) students are expected to have the expertise and skills to be ready to face the world of work. Along with the development of the era that prioritizes technology, of course, requires teachers as educators to take advantage of existing technology. Problems that arise due to the Covid-19 pandemic are a challenge for teachers to prepare for online learning. Many obstacles occur due to a lack of learning facilities such as media and practical equipment for practicum subjects. Learning media to facilitate online practicum learning is not yet available. Finally, the teacher can only give videos and assignments instead, without students having physical contact with practical equipment.

2. Methodology

This research adopted quantitative research (Patel & Patel, 2019), with the research design being experimental (Salim, 2019). The use of this method is in line with the research objectives to identify the level of effectiveness of multimedia products. The experimental design in this research is to use a non-quivalent control group design, which consists of a control class and an experimental class (Abdullah, 2015). This study took a population of SMK students in Surakarta, with a total sample of 136 students who were divided into 2 control classes and 2 experimental classes which were selected using the cluster technique (class).

Data collection techniques used test techniques (Abdullah, 2015), which were followed by instruments in the form of questions regarding student skills related to learning building engineering. Furthermore, the results of the instrument item reliability test used the Cronbach's Alpha test. Based on the table of reliability test results, the test results stated a score of 0.818. While the rtable for 30 students is 0.361 (N = 30), then the instrument used in this study is valid if rcount > rtable, so 0.818 > 0.361. This shows that the items to measure students' skills are declared reliable as a data collection tool.

The data analysis technique uses a hypothesis technique using an independent t-test (Salim, 2019). The following is a research hypothesis. The data obtained from the experimental results were analyzed using the Independent Sample Test t-test statistic with the help of the SPSS 25 program. Decision making on the hypothesis test of the effect of increasing student test scores is as follows:

H0 : there is no significant effect on improving students' practicum skills.
H1 : there is a significant effect on improving students' practicum skills.

Decision making can be done by:

Value Sig. < 0,05 or tcount > ttabel, so H0 declined.
Value Sig. ≥ 0,05 or jika tcount < ttabel, so H0 accepted.
As well as the analysis technique using the N-Gain Score assisted by the SPSS 25 application. The formula used to calculate the N-Gain score is (Meltzer, 2002):

$$N - Gain = \frac{T_{post} - T_{pre}}{T_{maks} - T_{pre}}$$

$$Percentage\ N - Gain = N - Gain\ x\ 100$$

Explanation:
Tpost = Average score post-test
Tpre = Average score pre-test
Tmaks = ideal score maximum (100)

The interpretation of the N-Gain score obtained through assessment, then converted in percentage form refers to the following table:

Table 1. N-Gain category

Percentage (%)	Category
< 40	Ineffective
40 - 55	Less effective
56 – 75	Effective enough
> 76	Effective

Source: (Meltzer, 2002)

Table 2. Category Interpretation of N-Gain Effectiveness

Persentase (%)	Tafsiran
< 40	Tidak Efektif
40 - 55	Kurang Efektif
56 – 75	Cukup Efektif
> 76	Efektif

Source: (Meltzer, 2002)

3. Results and Discussion

Assessment is carried out online by giving students access to download multimedia or materials and assessment forms. Students' skills were assessed using two stages of the test, namely the pre-test and post-test in the experimental class and the control class. At the pre-test stage from 24 – 28 May 2021, each class was given the task of answering questions and carrying out project assignments to measure skills (assessment instrument in Appendix 28). At the next meeting on June 7-11 2021, learning in the experimental class and control class was carried out using different methods. This difference in treatment is intended to differentiate the increase in scores between the experimental class using simulation multimedia, and the control class using conventional methods (assessment indicators in Appendix 29). The results of this test then became one of the references for the success of this study. The following is a presentation of students' pre-test and post-test scores in the graphs in Figures 39 and 40 (recap of student test scores in Appendix 30). The following is a comparison of the pre-test and post-test learning outcomes of students in the experimental and control classes at the State Vocational School (SMKN) 2 Surakarta and SMKN 5 Surakarta.

The pre-test and post-test at SMKN 2 Surakarta were conducted in two classes, namely class X DPIB A and X DPIB B. Class A served as the experimental class, while class B served as the control class. Each class consists of 34 students according to the data on the number of students. The average value of student learning in each class is taken.

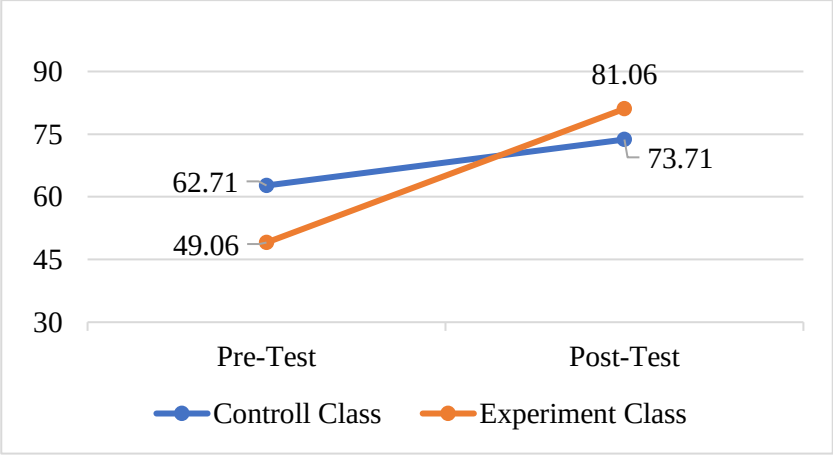

Figure 1. Comparison of the mean scores of students at SMKN 2 Surakarta

The graph shows that the average pre-test value for the control class is 62.71 and the experimental class is 49.06. Then the line on the graph shows the average increase in post-test scores in the control class and experimental class respectively 73.71 and 81.06. If you look at the graph, there is an increase in the average test scores in both classes. However, before making a decision, it is

necessary to conduct an effectiveness test to measure the increase in practical skills and find out how much influence the multimedia practical simulation has on learning land surveying techniques.

The pre-test and post-test activities at SMKN 5 Surakarta were carried out in two classes, namely class X DPIB A and X DPIB B. These two classes also needed the same, namely class A as the experimental class, while class B as the control class. Each class consists of 34 students according to the data on the number of students. Comparison of the average value of student learning outcomes.

The graph shows the average pre-test score for the control class is 55.18 and the experimental class is 44.12. Then the line on the graph shows the average increase in post-test scores in the control class and experimental class respectively 63.76 and 89.18. If you look at the graph, there is an increase in the average test scores in both classes. However, before making a decision, it is necessary to conduct an effectiveness test to measure the increase in practical skills and find out how much influence the multimedia practical simulation has on learning land surveying techniques.

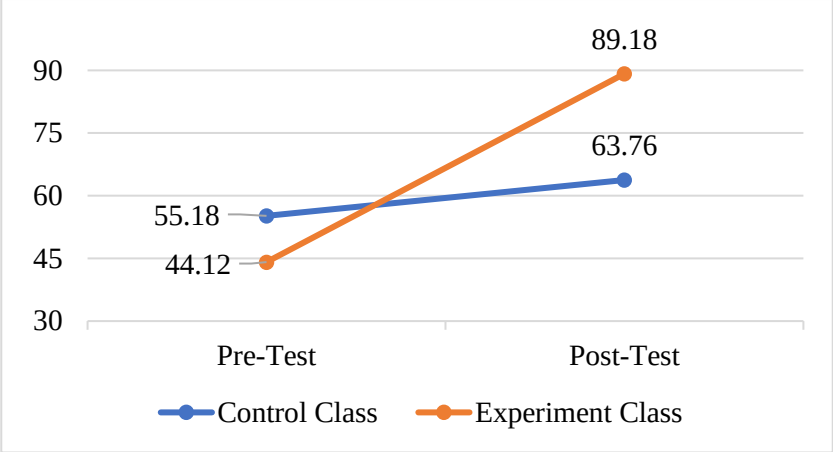

Figure 2. Comparison of the mean scores of students at SMKN 5 Surakarta

The effectiveness test was carried out to determine the effect of multimedia practicum simulations on learning land surveying techniques. Before carrying out the effectiveness test, the data that has been collected must fulfill the analysis by prerequisite testing which consists of a data normality test and a data homogeneity test. If the data analyzed is normally distributed and homogeneous, then the effectiveness test can be carried out.

In this study, the normality test was carried out using the Kolmogorov Smirnov test with the help of SPSS 25. The basis for making a decision for a normality test is when the significance level is greater than 0.05, and then the data is normally distributed. Conversely, when the significance level is less than 0.05, the data is not normally distributed.

Table 3. Test of normality of student practicum results

	Class	Kolmogorov-Smirnov			Normality
		Statistic	N	Sig.	
Student Practicum Results (Pre-Post Test)	Experiment	.126	68	.090	Normal
	Control	.091	68	.200	Normal

Table 3 shows the results of the Kolmogorov-Smirnov statistics in the experimental class and the control class, each with a significance value of 0.090 and 0.200. Both classes have normally distributed data (Sig. > 0.05), so it can be continued to test the homogeneity of the data.

Data analysis in the homogeneity test used Levene's statistical test to obtain information about the similarity between the population variances used in the product effectiveness test. The basis for making a homogeneity test decision is, if the significance level is greater than 0.05 (Sig. > 0.05) then the variance of the data used is homogeneous and can be continued for hypothesis testing.

Table 4. Test of homogeneity of student practicum results

Levene Statistic	***df1***	***df2***	***Sig.***
1.496	1	134	.230

The results of the homogeneity test can be seen in Table 11. Based on this table, it is known that the value of Sig. Based on the Mean of 0.230 > 0.05. These results mean that the variance of the data is homogeneous. Thus the homogeneity requirements are met and a hypothesis test can be carried out to determine the effectiveness of the practicum simulation multimedia on all data from the soil measurement technique practicum.

Furthermore, in order to determine the effectiveness of practicum simulation multimedia products in learning soil surveying techniques, the t test (independent sample t-test) is used. The decision-making criteria for hypothesis testing are as follows:

This section is a comparative or descriptive analysis of the study based on the study results, previous literature, etc. The results should be offered in a logical sequence, giving the most important findings first and addressing the stated objectives. The author should deal only with new or important aspects of the results obtained. The relevance of the findings in the context of existing literature or contemporary practice should be addressed.

- If the value of the significance level (Sig.) <0.05 or if $t_{count} > t_{table}$, then H0 is rejected and H1 is accepted
- If the significance level value (Sig.) > 0.05 or if $t_{count} < t_{table}$, then H0 is accepted and H1 is rejected

Hypothesis testing was carried out to prove 'does multimedia have a significant effect on increasing student scores?'. The hypothesis that has been formulated to find out the test decision is as follows:

H_0 = practicum simulation multimedia products have no significant effect on improving the operating skills of students' flat measuring instruments.
H_1 = Multimedia practicum simulation products have a significant effect on improving the operating skills of students' flat measuring instruments.

The results of the independent sample t-test statistical analysis with the help of the SPSS 25 application.

Table 5. Independent samples test results

	t-test for Equality of Means						
						95% Confidence Interval of the Difference	
Practicum Results Learners	t	df	Sig. (2-tailed)	Mean Diff	Std. Error Diff	Lower	Upper
Equal variances assumed	14.951	134	.000	24.162	1.616	27.358	20.965
Equal variances not assumed	14.951	123.248	.000	24.162	1.616	27.361	20.963

Based on the statistical analysis that has been shown in the table above, it is known that the value of Sig. (2-tailed) 0.000 <0.05, so that it refers to the criteria for making a decision to test the hypothesis 'H_0 is rejected and H_1 is accepted'. If we look at the column 't' (t_{count}), we get a score of 22,301. Then, the number of students who took the test was 134 students (df = 134), who had a ttable value of 1.65630 at a significance level of 0.05. Thus, t_{count} (14,951) > t_{table} (1.65630) with the test decision 'H0 is rejected and H_1 is accepted'. Thus, the conclusion obtained from testing the hypothesis is that the practicum simulation multimedia product has a significant effect on improving the operating skills of students' flat measuring instruments.

The level of effectiveness of practicum simulation multimedia products is carried out through further tests using calculations that refer to the Gain score. The following are the results of the Gain score statistical test using data obtained from the pre-test and post-test scores of students in the control class and the experimental class. Gain score test results (N-Gain) were processed with the help of the SPSS 25 application.

Table 6. Gain score test results (N-Gain)

Description	Experiment Class		Control Class	
	Pre-test	**Post-test**	**Pre-test**	**Post-test**
Average Score	46,59	85,12	58,94	68,74
N-Gain Score	0,72		0,23	
N-Gain Score (%)	71,82		22,74	
Category (Meltzer)	Moderate		Low	
Interpretataion (Hake)	Effective Enough		Ineffective	

The results of the N-Gain test are interpreted in categories that refer to the table above, and then the percentage of N-Gain is interpreted for its effectiveness based on Table 6. Based on the calculation results of the N-Gain test in Table 13, the N-Gain score for the experimental class is 0.72 which is included in the N-Gain score with the category of 'moderate' and the interpretation of 'fairly effective'. The control class N-Gain test result of 0.23 is included in the N-Gain score with the 'low' category and the interpretation of 'ineffective'.

Based on the statement of effectiveness test results, the use of multimedia practical simulations is quite effective in improving the operating skills of flat measuring instruments for DPIB Vocational High School students in Surakarta.

Multimedia practicum simulations are assessed based on effectiveness before the final product can be made and distributed to students and teachers with a wider scope. The effectiveness of multimedia is measured based on the results of students' practicum assessments. The effectiveness of multimedia practicum simulations is carried out by assessing students' skills through two stages of testing, namely pre-test and post-test in the experimental class and the control class. The results of the assessment showed that the multimedia practicum simulation had a significant effect on improving students' skills in operating a flat measuring instrument. This statement is proven by the acquisition of scores based on statistical test results, which state that there is a mean difference between the experimental class and the control class. In addition, the mean post-test score of the experimental class is greater than the mean post-test value of the control class. These results indicate that learning land surveying techniques using a multimedia practicum simulation is more effective than a class using conventional methods or not using a multimedia practicum simulation.

Then, the results of the calculation of the N-Gain test show that the average test value for the experimental class using multimedia practicum simulations is included in the category of quite effective for improving students' skills. Putri & Sofyan (2020) developed a simulation-based interactive multimedia application for science practicum activities. The results showed that simulation-based interactive multimedia for science practicums received proper grades from media experts, very feasible from material experts, and very feasible from student respondents during the beta test. In addition, the developed interactive learning multimedia proved to be effective in improving skills based on significantly increased pre-test and post-test average scores.

Simulation multimedia was also developed by Sriandhi, Restu, & Sitompul (2021) to support the electricity practicum. The results of the data analysis prove the superiority of simulated multimedia as a practical and efficient practicum learning medium. Simulation multimedia can also be an alternative learning media for classes that lack practicum facilities and infrastructure so that student learning outcomes can increase and conform to established competency standards (Abdulah et al., 2021; Ni, 2017).
As with the development of multimedia to support previous online practicums, Mertayasa, Agustini, & Subawa (2022) stated that digital practicum learning multimedia is practically effective for learning in Vocational High Schools. The learning experience gained by students has been able to instill practicum skills through multimedia.

Based on research results that are strengthened by previous research, multimedia practicum simulations can be a tool that can increase the effectiveness of the online learning process (Rahmawati & Ramadan, 2021). The use of multimedia is proven to be able to overcome the problem of low student learning outcomes. Besides that multimedia can improve students' attitudes and learning outcomes both in online learning and blended learning (Bicen et al., 2014; Eyup & Oğuz, 2014). Multimedia that integrates simulation into learning can also represent a practical environment with artificial situations (Nurjanah et al., 2014; Sarsar et al., 2021). This is a good way to optimally improve students' practicum abilities (Sun et al., 2020). Thus, the effectiveness of multimedia simulations can support the implementation of online practicum activities (Roemintoyo et al., 2022). Practical simulation multimedia products can be used as one of the learning media for the practicum of land surveying techniques for students of the Construction and Property Engineering Vocational High School Program which are difficult to implement during distance learning (Kurniawan et al., 2019).

Based on the results of research and development, students' difficulties in understanding abstract material can be facilitated by using multimedia (Sriadhi, 2015; Sarac, 2017). This is consistent with the characteristics of multimedia which can visualize abstract and conceptual events into concrete so that they are easy to understand (Ma, 2021; Wouters et al., 2008). Good learning media can increase the achievement of understanding of what is learned while reducing the cognitive load in students' thinking processes (Mahdi, 2019). Malik & Agarwal (2012) states that the use of multimedia in the learning process can make it easier for educators when conveying material and information so that it makes it easier for students to understand the learning material.

Entering the era of the Industrial Revolution 4.0 and Society 5.0, the use and dissemination of information through digital networks and devices connected to the internet has significantly penetrated various aspects of life (Alvarez-Cedillo et al., 2019). This situation provides a great opportunity to use digital devices and networks as well as internet support in the learning process (Shiroishi et al., 2018; Skobelev & Borovik, 2017). SMK comprehensively links the study of technology, and the development of the acquisition of practical skills, attitudes, and life skills. In this context, educators play an important role in forming and producing competent graduates needed towards the Industrial Revolution 4.0 and Society 5.0 (Mulyadi, 2019). Teachers must be able to make students achieve competencies that are in accordance with industry needs. In this era, teachers are required to master skills, and the ability to adapt to new technologies and educational challenges globally (Paetsch & Drechsel, 2021).

5. Conclusion

The effectiveness of the practicum simulation multimedia is measured based on the results of the student practicum assessment. Multimedia practicum simulations are declared effective enough to be used as learning media to improve students' skills in operating flat measuring instruments. The findings of this study indicate that the impact of implementing practical multimedia products simulating the operation of flat measuring instruments is quite effective in improving students' land surveying skills. The results of this research and development certainly show that multimedia can not only improve students' abilities cognitively but also their skills as the results of the research conducted in this study. It's just that this research still has limitations, namely, it still contains one subject topic, and not all topics can be loaded because it will have an impact on the size of the multimedia file which will be larger so it is not flexible to install. digital device. This study suggests that future researchers can provide innovation through application to other subjects, as well as using simulation models that can be combined with other latest technologies, such as Augmented Reality.

Funding: This research received no external funding.
Conflicts of Interest: The authors declare no conflict of interest.
ORCID iD: https://orcid.org/0000-0002-4566-9694

References

[1] Abdulah, A., Mustadi, A., & Fitriani, W. (2021). PBL-Based Interactive Multimedia in Improving Critical Thinking Skills. JPI (*Jurnal Pendidikan Indonesia), 10*(1), 136. https://doi.org/10.23887/jpi-undiksha.v10i1.25521
[2] Abdullah, M. (2015). Metode Penelitian Kuantitatif. Aswaja Pressindo.
[3] AECT. (2022). The Definition and Terminology Committee. Association for Educational Communications Technology.
[4] Akliyah, I. S. (2021). Dampak Pembelajaran Online Terhadap Pendidikan Karakter. Seminar Nasional Pendidikan, FKIP UNMA 2021, 8(2), 340–344.
[5] Alvarez-Cedillo, J., Aguilar-Fernandez, M., Sandoval-Gomez, R., & Alvarez-Sanchez, T. (2019). Actions to be taken in Mexico towards education 4.0 and society 5.0. *International Journal of Evaluation and Research in Education, 8(*4), 693–698. https://doi.org/10.11591/ijere.v8i4.20278
[6] Bergdahl, N., & Nouri, J. (2021). Covid-19 and Crisis-Prompted Distance Education in Sweden. Technology, Knowledge and Learning, 26(3), 443–459. https://doi.org/10.1007/s10758-020-09470-6
[7] Bicen, H., Ozdamli, F., & Uzunboylu, H. (2014). Online and blended learning approach on instructional multimedia development courses in teacher education. Interactive Learning Environments, 22(4), 529–548. https://doi.org/10.1080/10494820.2012.682586
[8] Cahya, I. (2020). Di Tengah Pandemi, Teknologi Pendidikan Berpotensi Makin Berkembang. Merdeka.Com.
[9] Efendi, D., Radhia, & Rizki, R. (2017). Problematika lulusan SMK yang banyak pengangguran. INVOTEK: *Jurnal Inovasi, Vokasional Dan Teknologi, 17*(2).
[10] Eyup, Y., & Oğuz, K. (2014). The effect of multimedia software coursware on student attitudes. *Journal of Theory and Practice in Education, 10*(2), 316–330.
[11] Fuady, I., Sutarjo, M. A. S., & Ernawati, E. (2021). Analysis of Students' Perceptions of Online Learning Media During the Covid-19 Pandemic (Study of E-learning Media: Zoom, Google Meet, Google Classroom, and LMS). *Randwick International of Social Science Journal, 2*(1), 51–56. https://doi.org/10.47175/rissj.v2i1.177
[12] Godoy Jr., C. H. (2020). Augmented Reality for Education: A Review. *International Journal of Innovative Science and Research Technology, 5*(6), 39–45. https://doi.org/10.38124/ijisrt20jun256

[13] Kao, C.-C., & Luo, Y.-J. (2020). Effects of Multimedia-Assisted Learning on Learning Behaviors and Student Knowledge in Physical Education Lessons: Using Basketball Game Recording as an Example. *International Journal of Emerging Technologies in Learning (IJET), 15*(01), 119–139. https://doi.org/10.3991/ijet.v15i01.11393

[14] Kareem, A. A. (2018). The Use of Multimedia in Teaching Biology and Its Impact on Students ' Learning Outcomes. The Eurasia Proceedings of Educational & Social Sciences, 9(1), 157–165. https://dergipark.org.tr/download/article-file/531778

[15] Kurniawan, W., Darmaji, D., Astalini, A., Kurniawan, D. A., Hidayat, M., Kurniawan, N., & Farida, L. Z. N. (2019). Multimedia physics practicum reflective material based on problem-solving for science process skills. *International Journal of Evaluation and Research in Education, 8(*4), 590–595. https://doi.org/10.11591/ijere.v8i4.20258

[16] Kuswana, W. S. (2013). Dasar-dasar Pendidikan Vokasi dan Kejuruan. Bandung: Alfabeta.

[17] Lin, Y.-C., Hsieh, Y.-H., Hou, H.-T., & Wang, S.-M. (2019). Exploring students' learning and gaming performance as well as attention through a drill-based gaming experience for environmental education. *Journal of Computers in Education, 6(3), 315–334*. https://doi.org/10.1007/s40692-019-00130-y

[18] Lubis, A. H., Yusup, F., Dasopang, M. D., & Januariyansah, S. (2021). Effectivity of interactive multimedia with theocentric approach to the analytical thinking skills of elementary school students in science learning. Premiere Educandum : Jurnal Pendidikan Dasar Dan Pembelajaran, 11(2), 215. https://doi.org/10.25273/pe.v11i2.9658

[19] Ma, L. (2021). Multimedia simulation-based architecture cad system model. Computer-Aided Design and Applications, 18(S1), 53–64. https://doi.org/10.14733/CADAPS.2021.S1.53-64

[20] Mahdi, H. S. (2019). Using Multimedia-Assisted LINCS for Learning English Pronunciation. *International Journal of Emerging Technologies in Learning (IJET), 14*(09), 105–117. https://doi.org/10.3991/ijet.v14i09.10356

[21] Mahmood, S. (2021). Instructional Strategies for Online Teaching in COVID-19 Pandemic. Human Behavior and Emerging Technologies, 3(1), 199–203. https://doi.org/10.1002/hbe2.218

[22] Malik, S., & Agarwal, A. (2012). Use of Multimedia as a New Educational Technology Tool–A Study. *International Journal of Information and Education Technology, 2*(5), 468–471. https://doi.org/10.7763/ijiet.2012.v2.181

[23] Maryanti, N., & Apriana, D. (2019). Kompetensi siswa smk dalam menyongsong revolusi industri 4.0. Prosiding Seminar Nasional Pendidikan Program Pascasarjana Universitas PGRI Palembang, 2, 999–1015.

[24] Meltzer, D. E. (2002). The relationship between mathematics preparation and conceptual learning gains in physics: A possible "hidden variable" in diagnostic pretest scores. *American Journal of Physics, 70*(12), 1259–1268. https://doi.org/10.1119/1.1514215

[25] Menteri Pendidikan. (2020). Surat Edaran Nomor 4 tahun 2020 Tentang Pelaksanaan Pendidikan dalam Masa Darurat Covid-19. In Kementerian Pendidikan dan Kebudayaan Republik Indonesia.

[26] Mertayasa, I. N. E., Agustini, K., & Subawa, I. G. B. (2022). Developing Digital Learning Media Based on Cognitive Style for Multimedia Technology in Practicum Learning. Proceedings of the 4th International Conference on Vocational Education and Technology, 1–9. https://doi.org/10.4108/eai.27-11-2021.2315631

[27] Muizzuddin, M. (2019). Pengembangan Profesionalisme Guru dan Peningkatan Kualitas Pembelajaran. *Jurnal Kependidikan, 7(*1), 127–140. https://doi.org/10.24090/jk.v7i1.2957

[28] Mulenga, E. M., & Marbán, J. M. (2020). Is covid-19 the gateway for digital learning in mathematics education? Contemporary Educational Technology, 12(2), 1–11. https://doi.org/10.30935/cedtech/7949

[29] Mulyadi, Y. (2019). Vocational Teacher Perception on Industry 4.0 and Society 5.0. Global Conferences Series: Sciences and Technology (GCSST), Volume 2, 2019 The 1st International Conference on Education, Sciences and Technology, 2, 62–68. https://doi.org/10.32698/tech1315126

[30] Muñoz-Saavedra, L., Miró-Amarante, L., & Domínguez-Morales, M. (2020). Augmented and virtual reality evolution and future tendency. Applied Sciences (Switzerland), 10(1). https://doi.org/10.3390/app10010322

[31] Ni, D. (2017). Design and Research on English Listening Teaching Assisted by Computer Multimedia. *International Journal of Emerging Technologies in Learning (IJET), 12*(01), 32. https://doi.org/10.3991/ijet.v12i01.6053

[32] Nichols Hess, A., & Greer, K. (2016). Designing for Engagement: Using the ADDIE Model to Integrate High-Impact Practices into an Online Information Literacy Course. Comminfolit, 10(2), 264. https://doi.org/10.15760/comminfolit.2016.10.2.27

[33] Nugraha, C. A., & Wahyono, S. B. (2019). Developing Interactive Multimedia Learning for Psychomotor Domain to Students of Vocational High School. J*urnal Kependidikan: Penelitian Inovasi Pembelajaran, 3*(2), 220–235. https://doi.org/10.21831/jk.v3i2.21797

[34] Nurjanah, Suryadi, D., Sabanda, J., & Darhim. (2014). the Enhancement of Junior High School Students Computer-Based Interactive Multimedia Instruction. *International Journal of Education, 7*(2), 111–119.

[35] Paetsch, J., & Drechsel, B. (2021). Factors Influencing Pre-service Teachers' Intention to Use Digital Learning Materials: A Study Conducted During the COVID-19 Pandemic in Germany. Frontiers in Psychology, 12. https://doi.org/10.3389/fpsyg.2021.733830

[36] Patel, M., & Patel, N. (2019). Exploring Research Methodology. *International Journal of Research and Review, 6(*3), 48–55. https://www.ijrrjournal.com/IJRR_Vol.6_Issue.3_March2019/Abstract_IJRR0011.html#:~:text=Research methodology is a way, with the logic behind them.

[37] Putri, P., & Sofyan, H. (2020). A Sımulatıon-Based Interactive Learning Multimedia Development for Photosynthesıs and Respıratıon Practicum in Junior High Schools. *Journal of Educational Technology and Online Learning, 3*(3), 311–339. https://doi.org/10.31681/jetol.775947

[38] Rahmawati, F., & Ramadan, Z. H. (2021). Improving High-Level Thinking Skills in Students Through Powtoon-Based Animation Video Media. *Journal of Education Technology, 5*(4), 654. https://doi.org/10.23887/jet.v5i4.41037

[39] Roemintoyo, R., Miyono, N., Murniati, N. A. N., & Budiarto, M. K. (2022). Optimising the utilisation of computer-based technology through interactive multimedia for entrepreneurship learning. *Cypriot Journal of Educational Sciences, 17*(1), 105–119. https://doi.org/10.18844/cjes.v17i1.6686

[40] Salim, H. (2019). Penelitian Pendidikan : Metode, Pendekatan, dan Jenis. In Jakarta: Kencana.

[41] Saputri, D. Y., Rukayah, R., & Indriayu, M. (2018). Need Assessment of Interactive Multimedia Based on Game in Elementary School: A Challenge into Learning in 21st Century. *International Journal of Educational Research Review, 3*(3), 1–8. https://doi.org/10.24331/ijere.411329

[42] Sarac, H. (2017). Effect of Multimedia Assisted 7e Learning Model Applications on Academic Achievement and Retention in Students. *European Journal of Educational Research, 6(*3), 299–311. https://doi.org/10.12973/eu-jer.6.3.299

[43] Saripudin, S. (2017). FAKTOR-FAKTOR YANG MEMPENGARUHI KOMPETENSI PROFESIONAL GURU BIDANG KOMPETENSI KEAHLIAN TEKNIK INSTALASI TENAGA LISTRIK DI SMK. Innovation of Vocational Technology Education, 10(1). https://doi.org/10.17509/invotec.v10i1.5093

[44] Sarsar, F., Kale, Ö. A., Andiç-Çakır, Ö., Gueorguiev, T., Evstatiev, B., Georgieva, T., Kadirova, S., Mihailov, N., Różewski, P., Kieruzel, M., Lipczyński, T., Prys, M., & Leeuwen, M. (2021). Multicultural investigation of the students' acceptance of using digital learning materials in laboratory classes. Computer Applications in Engineering Education, 29(4), 883–896. https://doi.org/10.1002/cae.22322

[45] Shiroishi, Y., Uchiyama, K., & Suzuki, N. (2018). Society 5.0: For Human Security and Well-Being. Computer, 51(7), 91–95. https://doi.org/10.1109/MC.2018.3011041

[46] Skobelev, P., & Borovik, S. (2017). On The Way From Industry 4.0 to Industry 5.0: From Digital Manufacturing to Digital Society. *International Scientitic Journal "Industry 4.0", 2*(6), 307–311.

[47] So, W. W. M., Chen, Y., & Wan, Z. H. (2019). Multimedia e-Learning and Self-Regulated Science Learning: a Study of Primary School Learners' Experiences and Perceptions. *Journal of Science Education and Technology, 28*(5), 508–522. https://doi.org/10.1007/s10956-019-09782-y

[48] Sriadhi. (2015). THE EFFECT OF EXPLORATORY MULTIMEDIA LEARNING TOWARDS LEARNING OUTCOMES OF ELECTRICAL POWER GENERATION BASED ON DIFFERENCE OF STUDENTS' SPATIAL ABILITY. *Jurnal Education Science, 1*(1), 1–11.

[49] Sriadhi, S., Restu, R., & Sitompul, H. (2021). Multimedia simulation model for electrical laboratory learning. IOP Conference Series: Materials Science and Engineering, 1098(3), 032020. https://doi.org/10.1088/1757-899x/1098/3/032020

[50] Sun, Y., Hu, J., Li, G., Jiang, G., Xiong, H., Tao, B., Zheng, Z., & Jiang, D. (2020). Gear reducer optimal design based on computer multimedia simulation. *Journal of Supercomputing, 76*(6), 4132–4148. https://doi.org/10.1007/s11227-018-2255-3

[51] Thomas, M. S. C., & Rogers, C. (2020). Education, the science of learning, and the COVID-19 crisis. Prospects, 49(1–2), 87–90. https://doi.org/10.1007/s11125-020-09468-z

[52] Wouters, P., Paas, F., & van Merriënboer, J. J. G. (2008). How to optimize learning from animated models: A review of guidelines based on cognitive load. In Review of Educational Research (Vol. 78, Issue 3, pp. 645–675). https://doi.org/10.3102/0034654308320320