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Optimizing the Use of Simulation Technology in Digital Learning Content Development

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Abstract*— Education in the era of globalization that allows no limits to find all information is very easy and effective to do anywhere. By utilizing simulation technology in learning so that you can prepare even better. Of course there are stages that must be followed, such as knowing what positive effects are applied using simulation technology for the development of digital learning content, you have to know the methods with people who are experienced and knowledgeable in the field. By utilizing this technology in the form of digital learning content that is able to create effective and quality learning, so that it can make the next generation superior and competitive. Increasingly sophisticated technology can facilitate human work in all fields, especially in the field of education. Many people are competing to create interactive media, so they can earn from the media they create. This should also receive attention from parties related to the world of education. The method used in this study is a quantitative method by distributing a questionnaire containing 15 statements about this simulation technology for digital learning. The purpose of this research is to optimize the use of simulation technology to enhance digital learning for students so they are able to master the skills to use maximally, creatively and innovatively against this limitless technological development. The conclusion from this study is that technology greatly influences student learning development, one of which is by optimizing the use of simulation technology in digital learning. Students and teachers really get a big positive impact with the presence of this sophisticated tool. The limitation of this research is that researchers only conduct research at the school or madradah level, which in fact they need learning media like this in learning in class, so that the class atmosphere is more conducive and attracts students' attention to learning with focus.

***Keywords*— Optimal, Simulation Technology, Digital Learning**

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I. INTRODUCTION

In this sophisticated era, the world of education is required to be able to adapt and be able to utilize technology that is growing rapidly. (Mustafiyanti et al., 2023). The goal is to improve learning for students, so that they are able to create broad-minded and healthy competitors with those who are already proficient in their fields. Skills for creating educational content can also be trained by educators. (Utami et al., 2023). Of course, it must also be supported by parents, teachers and also the community to be able to realize the golden generation. It can make them have the opportunity to get a decent job after graduating from college, and have a wise mind towards a problem in life. (Liam et al., 2023). Able to adapt, and have high value. So that the quality of self develops rapidly, to advance the country. Critical, creative, and innovative thinking that is indispensable in this borderless era of globalization. (Aceto et al., 2018). All aspects of life that are not spared from technology are increasingly playing an important role, side by side with modern life (Saskia et al., 2023). For example, when learning in class, students are required to be able to master the learning delivered by the teacher. Then the teacher must be creative in delivering, one of which uses digital-based interactive media in the form of interesting videos. So that students are excited in mastering a science.

The problem of education and teaching is a fairly complex problem in which many factors influence (Chambon et al., 2018). One of these factors includes the teacher. Teachers are a component factor of education and teaching that plays an important and main role. The success of the learning process is largely determined by a teacher (Asmanda et al., 2022). The teacher's job is to convey subject matter to students through communication interactions using textbooks and media in the learning process. The success of the teacher in delivering the material is highly dependent on the provision of the use of textbooks and educational media that are in accordance with the conditions of the learning environment and the conditions of the students themselves (Maulani et al., 2022). Education is a bridge to the future of a learner, both as a bridge of ideas, values, between generations and civilizations. Like clockwork, second by second must move to move the gears of the minute wheel which in turn will move the gears of hours, days, months and even years (Dito & Pujiastuti, 2021). Teacher professionalism is a must in realizing information and communication technology-based schools. The advancement of science causes education to advance. A teacher who holds the title of professional teacher should follow the development of science and technology (Li, 2021). Professional development will realize a knowledge-based school, which is an understanding of learning, curriculum and human development including learning styles.

Science is developing at a rapid pace. Advances in information and communication technology have a major impact on all fields, including education (Rahmaniar & Prastowo, 2021). Formal education in Indonesia is being actively promoted, unfortunately the implementation of information technology is still faltering due to various technical constraints. The phenomenon shows that there is a gap in the perception and ability of teacher resources in utilizing information technology-based learning facilities (Sastradipraja, 2020). The influence of information and communication technology in the world of education is increasingly felt in line with the shift in learning patterns from conventional face-to-face to a more open and media education. The development of technology is taking place so fast. So it is appropriate for experts to call it the millennial age (Saputra et al., 2020). Education is expected to be able to create an active learning atmosphere so that the increase in students' interest in learning will increase, it is time to leave the old conventional theories relying on package books alone as reference material. So that students are

bored and bored in learning (Rahmadhani & Efronia, 2021). The package book is the main reference and needs to get other references to support the achievement of learning objectives towards students who have knowledge and have noble morals (Arifin et al., 2022). Education is a conscious and planned effort to create a learning atmosphere and learning process, so that students actively develop their potential to have religious spiritual strength, self-control, personality, intelligence, noble character and skills needed by themselves, the nation and the state.

Teacher competence not only plays a role in encouraging students' interest in learning, but also in motivating students to be more active and passionate about learning. (Arifin et al., 2022). Then the teacher has succeeded in activating and stimulating students in learning, this will affect the learning outcomes in the classroom to be of higher quality and quality. There is a very close and mutually beneficial relationship between learner interest and the use of media in the information technology-based learning process (Coman et al., 2020). High learner learning outcomes encourage learners to maintain by studying hard and earnestly. The classical learning approach using the lecture method is still favored by teachers because it has several advantages over other methods (Javaid & Khan, 2021). The advantages of the lecture method include saving time and media. Besides, it is also economical and practical in delivering learning content, but it must be recognized that lecture learning does not always work well (Gumono et al., 2022). The negative symptom that teachers often complain about is that students become bored quickly and do not pay attention to the material being lectured. Learners talk to each other with their friends regardless of the teacher who is lecturing, it is something that is not natural for students to do (Batubara, 2015). So that class conditions are not conducive and learning materials do not enter the brains of students.

Learning can be successful if it is supported by various factors, including by utilizing information technology-based learning in learning (Dygalo et al., 2020). As well as using simulation technology in improving the development of digital learning content that can change the way students understand learning. Making students easy to accept and understand the knowledge conveyed by the teacher. The teacher also becomes easy and not complicated to develop learning media (Almousa et al., 2019). But teachers must also be provided with training in advance to be able to develop digital learning content. Such as attending seminars, workshops, training in making digital content that is interesting and of course educational (De Paula Ferreira et al., 2020). Simulation technology is computer software and hardware for analyzing the potential outcomes of a given situation, based on known factors and the introduction of one or more variables that have the ability to influence the outcome of a given situation. This type of computer is very helpful in many different situations, ranging from creating lesson plans that suit the needs of the learner, launching lesson relationship schemes, and more (Buda et al., 2018). The idea behind creating a simulation is to minimize the likelihood of undesirable outcomes, while also uncovering factors that might increase the chances of success.

When using simulation technology to create a simulation tool, the process is often divided into three different phases or steps. The first step in this process is usually called the design phase, then execution, finally analyzing the results of the execution phase (Huang & Huang, 2022). With learning content for a series of knowledge materials, concepts and skills that need to be learned by students based on the applicable curriculum (Wang et al., 2021). Make students productive by utilizing the sophistication of interesting and highly competitive content features. Students can write blogs, poems, short stories, make videos on TikTok, Instagram and other platforms easily and fun (Bergamo et al., 2022). It is not difficult to access it with only the internet and typing fingers can feel the magic of this sophisticated technology. They will also learn to earn money by utilizing

technology intelligently and wisely, as well as being able to utilize free time by filling it with making creative and innovative learning media (Chang et al., 2021). Of course, this needs the support of parents and teachers. A high spirit of learning new and useful things will also appear in students.

According to (Rahmat et al., 2019), stated in his research entitled the development of simulation technology-based learning media to improve student understanding, aiming to determine the effectiveness of learning media for cognitive development and the development of students' ways of thinking. Furthermore, according to (Husain et al., 2021), who stated in his research entitled E-Learning digital simulation subjects at vocational high school SMK 3 Gorontalo, aims to be able to maximally utilize the use of e-learning media for digital simulation subjects in this modern era, so that the expected learning objectives can be achieved properly. According to (Hakiki et al., 2022), stated in his research entitled the effect of learning models with simulation instruction technology on the learning outcomes of class IX computer engineering courses, aiming to find out how the results of the utilization of interactive learning media, namely digital technology in improving digital learning which is growing rapidly. According to (Andi Wibowo & Saepuloh, 2020), which states in his research entitled the development of digital-based technology media in digital simulation subjects class X SMA Banyuwangi, aims to advance learning by using learning media that suits students, namely this digital-based technology.

The purpose of this research is to maximally develop simulation technology to improve higher quality and superior teaching, so as to create graduates who are technologically literate and competitive, have high competitiveness and are able to master skills in the IT field. Students will also easily adapt to all the rapid changes that occur. Teachers will also find it easy to give assignments and monitor students' progress in doing so. Support from parents is also very much expected for the development of student learning at home. So that learning objectives can be achieved properly and well. Class conditions will be more conducive and students are able to receive lessons easily and can apply the lessons learned by utilizing existing technology to support their performance to be easy and efficient. And can be broad-minded and master a lot of knowledge for the good of his life.

II. RESEARCH METHODS

The method in this study uses quantitative methods. The definition of quantitative methods is Quantitative research is a systematic scientific study of parts and phenomena and the causality of their relationships. The purpose of quantitative research is to develop and use mathematical models, theories and hypotheses related to a phenomenon (Fuadiah, 2022). Quantitative method is a research method used to examine certain populations and samples, sampling is done randomly, then analyzed quantitatively or statistically with the aim of testing predetermined hypotheses. Quantitative research activities begin with theory, hypothesis, research design, research subjects, data collection, data processing, data analysis, and drawing conclusions. Or in another sense that quantitative research is an attempt by a researcher to find knowledge to present data in the form of numbers (Risdiana Chandra Dhewy, 2022). The numbers obtained are used to analyze the information. In simpler language, quantitative research is scientific research that is systematically organized into parts and tries to find causality to determine the relationship.

Based on the perspective of its purpose, quantitative research has several points, including aiming to develop mathematical models. Where this research does not just use theories taken from literature review or theory alone, but it is also very important to build hypotheses that have a connection with the natural phenomena to be studied (Sari et al., 2022). So this quantitative research has an important purpose in making measurements. After all, measurement is at the

center of research, because the measurement results will help in seeing the fundamental relationship between empirical observations and quantitative data results. As for other quantitative research objectives, namely helping to determine the relationship between variables in a population. It also helps in determining the research design. Talking about quantitative research design, it has two forms, namely descriptive studies and experimental studies. Descriptive study research is said if the researcher only tests the relationship between variables only once. Meanwhile, what is meant by experimental study research is when researchers make measurements between variables before and after the study. So, this before and after measurement is nothing but done to find out the cause and effect. It can also be used to find out what phenomena the research is doing.

The characteristics of this quantitative method are Using a deductive mindset, using positivistic logic, using procedural planning, aiming to compile nomothetic science, data is collected and processed according to plan, involving numerical calculations or quantification in data variables, analyzed using statistical formulas, data analysis is carried out after the data is successfully collected, referred to as scientific research. Quantitative method research must use steps that are in accordance with the research plan to be carried out (Firmansyah et al., 2021). To better understand, here are the steps of research with a quantitative approach. Of course, a research starts with a question about a phenomenon or problem that exists. The formulation of the problem is the first point that must be observed by researchers in making a study. After finding the problem to be studied, the researcher then compiles hypotheses and arguments that explain the factors that link the problem with the theory that has been tested. It should be noted that when compiling a framework, it must be based on scientific studies that have been aimed at by paying attention to empirical factors relevant to the problem. Hypotheses collected from several facts must be formulated by paying attention to whether there are scientific studies that are relevant to the hypothesis. After the research process is carried out, the researcher must conclude the hypothesis that has been tested. After the results are concluded, it will be known that the hypothesis is accepted or rejected.

III. Result Discusion

This research is to optimize the use of simulation technology in the development of digital learning content to the maximum so that learning objectives can be achieved. Technology is a practical application of knowledge especially in certain fields; a way of accomplishing tasks especially by using technical processes, methods, or knowledge; and also a special aspect of a particular field of business. Technology is the overall means of providing goods necessary for the survival and comfort of human life. The use of technology by humans began with the conversion of natural resources into simple tools. In general, technology can be interpreted as a science related to tools or machines created to facilitate solving problems or daily work. So it is hoped that the presence of technology can have a good influence on life. The positive impacts of digital technology include accelerating communication and making work easier, simplifying and shortening the process of exchanging information. Increase work efficiency and effectiveness. Enables fully online learning. Can communicate with others even though they are not in the same location. while the negative impacts include fostering individualism, slander, and anti-social attitudes.

Simulation is a process of imitating something real and its surroundings. The action of doing this simulation generally describes the key characteristics of the behavior of a physical system or system. What is the purpose of simulation, namely simulation can be used to show changes in the structure of a Real System that actually cannot be studied in real time. Thus simulation can help change the Real System only by entering a little data. The importance of simulation is that it can increase learners' motivation and attention to the

topic and learners' learning, as well as increase direct involvement and active participation of learners in the learning process, improve students' ability to learn cognitive, including factual information. Simulation technology is utilizing existing technology to conduct learning exercises in order to know what needs to be prepared and overcome problems that may occur in the future. Also to make it easier for teachers to evaluate their students' learning.

Digital content learning is making learning interesting and popular with students, so that students are able to compete and have high self-esteem. He is also able to create creative and innovative learning content. Learning content is a series of knowledge materials, concepts, and skills that need to be learned by students based on the applicable curriculum. Learning content is inseparable from the teaching and learning process. Content-based learning is learning that prioritizes the understanding of material or cognitive aspects of students. Before the existence of competency-based learning, most teachers still referred to this learning, where students were required to understand the material being studied with or without knowing the basic concepts. The assessment carried out also still refers to the level of students' understanding of the material. Therefore, participants are said to be smart if they are able to memorize the material well. By preparing effective learning content and materials, the learning process will be more structured and organized, so that students can understand the material better. In addition, preparing learning content and materials that are in accordance with the competencies to be achieved also helps teachers in evaluating student learning outcomes objectively. The following table contains 15 statements about the importance of simulation technology development to learning.

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Simulation technology can have a major positive impact on students' skill development	50%	55%	0%	0%
Increase knowledge about IT development	45%	60%	2%	0%
Can earn income from utilizing educational digital content	70%	30%	0%	0%
Able to become a competitive student in their field	25%	70%	0%	0%
Teachers become easier to provide learning in class	30%	70%	0%	0%
Advancing education to be more qualified	15%	80%	5%	0%
Teachers begin to master soft skills in educating children	12%	85%	1%	0%
Support from parents is needed in developing student intelligence	35%	70%	2%	0%
Students are	50%	50%	0%	0%

required to be proficient in mastering IT knowledge				
Many positive things are obtained with the existence of digital content	35%	63%	3%	0%
There are also negative impacts from the development of this technology	60%	40%	0%	0%
The problem of students who are lazy to learn can be resolved	40%	60%	0%	0%
Students easily search for global information	40%	65%	4%	0%
Make it easy for students to communicate with their friends	50%	50%	0%	0%
Students are better prepared to face life's problems	50%	50%	2%	0%

From the table above, there are 15 statements about technology development to improve digital learning with maximum and quality. The statement that simulation technology can have a positive impact on the development of students' skills, obtained a percentage of 50% in the strongly agree category. While in the agree category, the percentage is 55%, in the disagree category, the percentage is 0%, as well as the strongly disagree category, the percentage is 0% as well. Furthermore, the statement that increasing knowledge about IT developments, obtained a percentage of 45% in the strongly agree category. Meanwhile, the agree category obtained a percentage of 60%, in the disagree category obtained a percentage of 2% and a strongly disagree category obtained a percentage of 0%. In the statement that you can earn income from utilizing educational digital content, get a percentage of 70% in the strongly agree category. While in the category of agreeing to get a percentage of 70%, in the category of disagreeing to get a percentage of 0%, as well as the category of strongly disagreeing also get a percentage of 0%.

Furthermore, the statement that it is easier for teachers to provide learning in class, obtained a percentage of 30% in the strongly agree category. Whereas in the agree category, it got a percentage of 70% in the disagree category getting a percentage of 0% and a percentage of 0% also in the strongly disagree category. The statement that advancing education becomes of higher quality, obtained a percentage of 15% in the strongly agree category. While the percentage of 80% in the agree category, in the disagree category obtained a percentage of 5% and in the strongly disagree category obtained a percentage of 0%. Furthermore, in the statement that teachers began to master soft skills in educating children, obtained a percentage of 12% in the strongly agree category. Meanwhile, the agree category received a percentage of 85%, in the disagree category obtained a percentage of 1% and in the strongly disagree category obtained a percentage of 0%. In the statement that support from parents is needed in developing students' attitudes and intelligence, obtained a percentage of 35% in the strongly agree category. Meanwhile, a percentage of 70% in the agree category, in the disagree category obtained a percentage of 2% and

in the strongly disagree category obtained a percentage of 0%.

Furthermore, in the statement stating that students are required to master knowledge about IT, obtained a percentage of 50% in the strongly agree category. Whereas in the agree category, it obtained a percentage of 50%, in the disagree category, it obtained a percentage of 0%, and likewise, the strongly disagree category obtained a percentage of 0% as well. In the statement stating that many positive things are obtained by the existence of innovative and creative digital learning content, a percentage of 35% in the category strongly agreed with the statement. Whereas in the agree category, it got a percentage of 63%, in the disagree category it got a percentage of 3% and in the strongly disagree category it got a percentage of 0%. Furthermore, the statement stating that there are also negative impacts from the development of this digital content, obtained a percentage of 60% in the strongly agree category. While in the agree category, it gets a percentage of 40%, in the disagree category it gets a percentage of 0% and finally in the strongly disagree category it gets a percentage of 0%.

The statement stating that the problem of students who are lazy to learn because they think it is not interesting how the teacher conveys the material can be overcome by utilizing this latest technology, obtained a percentage of 40% in the strongly agree category. Meanwhile, in the agree category, the percentage was 60%, in the disagree category, the percentage was 0% and in the strongly disagree category, the percentage was 0% as well. Furthermore, the statement stating that students easily find the information needed, received a percentage of 40% in the strongly agree category. While in the agree category, it obtained a percentage of 65%, in the disagree category it obtained a percentage of 4% and finally in the strongly disagree category obtained a percentage of 0%. In the statement stating that it makes it easier for students to communicate with their friends, a percentage of 50% in the category strongly agreed with the statement. Whereas in the agree category, it obtained a percentage of 50%, in the disagree category it got a percentage of 0% and so did the strongly disagree category get a percentage of 0%. Finally, the statement that students are better prepared to face life's problems, obtained a percentage of 50% in the strongly agree category. As for the agree category, it got a percentage of 50% as well, for the disagree category and the strongly disagree category obtained a percentage of 0% as well.

The result of this study is that it is very useful to use simulation technology to improve digital learning in a maximum and quality way, in order to be able to create a generation that is technologically literate and able to compete healthily with people who are more advanced. Meraja will also be able to master IT skills, so that they can create creative and innovative educational content. Make people civilized and able to adapt to the inevitable changes of globalization. Have a critical mind towards the problems faced and can be responsible for their own choices. The purpose of this research is to be able to provide the benefits of the latest technological developments for education, one of which is simulation technology for digital-based interactive learning. As a result of 15 statements with the distribution of questionnaires, it is proven that the importance of using interactive learning media to support student learning in class, so that great benefits can be felt.

IV. CONCLUSIONS

Based on the discussion of the research above, it can be concluded that optimizing the use of simulation technology in developing digital learning content to the maximum will have a major positive impact on education. Students will easily understand lessons with digital-based interactive media such as simulation technology. Which with this technology helps students to understand the obscurity and complexity of the material being studied, as a student's independent learning material and can help teachers convey things that have not been conveyed. Teachers can also provide

assignments by utilizing this technology, so students can be more creative and innovative in creating learning content. This will also develop students' skills to be competitive and have a high value for globalization changes, ready to adapt to all existing changes. Critical thinking in dealing with problems and being able to solve problems calmly. The research method used in this study is a quantitative method by distributing questionnaires to respondents, containing 15 statements with categories of strongly agree, agree, disagree, and strongly disagree. The result is that it is very influential on the benefits of simulation technology for the development of students' learning. If utilized optimally and know the right way to use it. And supported by learning methods that suit the needs of students. The purpose of this research is to be able to develop creative and innovative simulation technology to develop digital learning content that is able to adapt to all developments. Students are also able to compete and compete healthily with those who are already proficient in their fields. Become a responsible and independent human being, can strive to develop their potential for the better. And of course it will make parents and teachers proud who have educated them.

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VI. References

Aceto, G., Persico, V., & Pescapé, A. (2018). The role of Information and Communication Technologies in healthcare: Taxonomies, perspectives, and challenges. *Journal of Network and Computer Applications*, *107*, 125–154. https://doi.org/10.1016/j.jnca.2018.02.008

Almousa, O., Prates, J., Yeslam, N., Mac Gregor, D., Zhang, J., Phan, V., Nielsen, M., Smith, R., & Qayumi, K. (2019). Virtual Reality Simulation Technology for Cardiopulmonary Resuscitation Training: An Innovative Hybrid System With Haptic Feedback. *Simulation & Gaming*, *50*(1), 6–22. https://doi.org/10.1177/1046878118820905

Andi Wibowo, R. I., & Saepuloh, L. (2020). PENGEMBANGAN MEDIA PEMBELAJARAN AUGMENTED REALITY PADA SIMULASI KOMUNIKASI DIGITAL DI SMK MUHAMMADIYAH 1 SUKABUMI. *Utile: Jurnal Kependidikan*, *6*(2), 160–167. https://doi.org/10.37150/jut.v6i2.925

Arifin, M. M., Prastowo, S. B., & Harijanto, A. (2022). EFEKTIVITAS PENGGUNAAN SIMULASI PHET DALAM PEMBELAJARAN ONLINE TERHADAP HASIL BELAJAR SISWA. *JURNAL PEMBELAJARAN FISIKA*, *11*(1), 16. https://doi.org/10.19184/jpf.v11i1.30612

Asmanda, N. M., Susanto, E. H., & Sudarto, S. (2022). Analisis Konten E-Marketing Campaign JD.ID #Joychallenge Menggunakan Influencer Marketing. *Prologia*, *6*(1), 108. https://doi.org/10.24912/pr.v6i1.10317

Batubara, H. H. (2015). Pengembangan Media Pembelajaran Interaktif pada Materi Operasi Bilangan Bulat. *Muallimuna : Jurnal Madrasah Ibtidaiyah*, *1*(1), 1. https://doi.org/10.31602/muallimuna.v1i1.271

Bergamo, P. A. D. S., Streng, E. S., De Carvalho, M. A., Rosenkranz, J., & Ghorbani, Y. (2022). Simulation-based training and learning: A review on technology-enhanced education for the minerals industry. *Minerals Engineering*, *175*, 107272. https://doi.org/10.1016/j.mineng.2021.107272

Buda, M., Maki, A., & Mazurowski, M. A. (2018). A systematic study of the class imbalance problem in convolutional neural networks. *Neural Networks*, *106*, 249–259. https://doi.org/10.1016/j.neunet.2018.07.011

Chambon, S., Galtier, M. N., Arnal, P. J., Wainrib, G., & Gramfort, A. (2018). A Deep Learning Architecture for Temporal Sleep Stage Classification Using Multivariate and Multimodal

Time Series. *IEEE Transactions on Neural Systems and Rehabilitation Engineering*, *26*(4), 758–769. https://doi.org/10.1109/TNSRE.2018.2813138

Chang, H.-Y., Wu, H.-F., Chang, Y.-C., Tseng, Y.-S., & Wang, Y.-C. (2021). The effects of a virtual simulation-based, mobile technology application on nursing students' learning achievement and cognitive load: Randomized controlled trial. *International Journal of Nursing Studies*, *120*, 103948. https://doi.org/10.1016/j.ijnurstu.2021.103948

Coman, C., Țîru, L. G., Meseșan-Schmitz, L., Stanciu, C., & Bularca, M. C. (2020). Online Teaching and Learning in Higher Education during the Coronavirus Pandemic: Students' Perspective. *Sustainability*, *12*(24), 10367. https://doi.org/10.3390/su122410367

De Paula Ferreira, W., Armellini, F., & De Santa-Eulalia, L. A. (2020). Simulation in industry 4.0: A state-of-the-art review. *Computers & Industrial Engineering*, *149*, 106868. https://doi.org/10.1016/j.cie.2020.106868

Dito, S. B., & Pujiastuti, H. (2021). Dampak Revolusi Industri 4.0 Pada Sektor Pendidikan: Kajian Literatur Mengenai Digital Learning Pada Pendidikan Dasar dan Menengah. *Jurnal Sains Dan Edukasi Sains*, *4*(2), 59–65. https://doi.org/10.24246/juses.v4i2p59-65

Dygalo, V., Keller, A., & Shcherbin, A. (2020). Principles of application of virtual and physical simulation technology in production of digital twin of active vehicle safety systems. *Transportation Research Procedia*, *50*, 121–129. https://doi.org/10.1016/j.trpro.2020.10.015

Firmansyah, M., Masrun, M., & Yudha S, I. D. K. (2021). ESENSI PERBEDAAN METODE KUALITATIF DAN KUANTITATIF. *Elastisitas - Jurnal Ekonomi Pembangunan*, *3*(2), 156–159. https://doi.org/10.29303/e-jep.v3i2.46

Fuadiah, D. (2022). Pengembangan Instrumen Tes Kemampuan Penalaran Kuantitatif bagi Siswa Kelas VI SD/MI. *Jurnal Ilmiah Pendidikan Dasar*, *9*(1), 45. https://doi.org/10.30659/pendas.9.1.45-67

Gumono, G., Sarwono, S., Yulistio, D., Pitawan, K. A., Solihin, M., & Julianto, E. (2022). Development of local wisdom-based thematic teaching materials to improve adaptive cultural literacy. *Community Empowerment*, *7*(6), 978–987. https://doi.org/10.31603/ce.6560

Hakiki, M., Sabir, A., Kartika, R., & Al-ihsan, M. I. (2022). PENGARUH MODEL PEMBELAJARAN EXPLICIT INSTRUCTION TERHADAP HASIL BELAJAR SIMULASI DIGITAL MATAKULIAH KELAS X TEKNIK KOMPUTER DAN JARINGAN (TKJ). *Jurnal Muara Pendidikan*, *7*(1), 60–69. https://doi.org/10.52060/mp.v7i1.763

Huang, S., & Huang, L. (2022). CLO3D-Based 3D Virtual Fitting Technology of Down Jacket and Simulation Research on Dynamic Effect of Cloth. *Wireless Communications and Mobile Computing*, *2022*, 1–11. https://doi.org/10.1155/2022/5835026

Husain, H., Gobel, C. Y., & Dunggio, Z. K. (2021). E-LEARNING MATA PELAJARAN SIMULASI DIGITAL PADA SEKOLAH MENENGAH KEJURUAN NEGERI 3 KOTA GORONTALO. *JSAI (Journal Scientific and Applied Informatics)*, *4*(3), 280–285. https://doi.org/10.36085/jsai.v4i3.1814

Javaid, M., & Khan, I. H. (2021). Internet of Things (IoT) enabled healthcare helps to take the challenges of COVID-19 Pandemic. *Journal of Oral Biology and Craniofacial Research*, *11*(2), 209–214. https://doi.org/10.1016/j.jobcr.2021.01.015

Li, J. (2021). Design of Human-computer Interaction System Using Gesture Recognition Algorithm from the Perspective of Machine Learning. *2021 IEEE International Conference on Computer Science, Electronic Information Engineering and Intelligent Control Technology (CEI)*, 120–124. https://doi.org/10.1109/CEI52496.2021.9574581

Liam, L., Hui, H., & Carsten, L. (2023). Utilization of ICT in Learning the History of Islamic Culture. *Scientechno: Journal of Science and Technology*, *2*(1), 64–79. https://doi.org/10.55849/scientechno.v2i1.49

Maulani, S., Nuraisyah, N., Zarina, D., Velinda, I., & Aeni, A. N. (2022). Analisis Penggunaan Video sebagai Media Pembelajaran Terpadu terhadap Motivasi Belajar Siswa. *Jurnal Pendidikan Dan Teknologi Indonesia*, *2*(1), 539–546. https://doi.org/10.52436/1.jpti.134

Mustafiyanti, M., Putri, M. P., Muyassaroh, M., Noviani, D., & Dylan, M. (2023). A Form of Independent Curriculum, an Overview of Independent

Learning at State Elementary School 05 Gelumbang Muaraenim. *Pengabdian: Jurnal Abdimas*, *1*(2), 82–96. https://doi.org/10.55849/abdimas.v1i2.185

Rahmadhani, S., & Efronia, Y. (2021). Penggunaan E-Modul Di Sekolah Menengah Kejuruan Pada Mata Pelajaran Simulasi Digital. *JAVIT : Jurnal Vokasi Informatika*, 5–9. https://doi.org/10.24036/javit.v1i1.16

Rahmaniar, E., & Prastowo, A. (2021). Implikasi Model Simulasi berbasis Teknologi Informasi dan Komunikasi Terhadap Keaktifan Belajar Siswa di Sekolah Dasar. *EDUKATIF : JURNAL ILMU PENDIDIKAN*, *4*(1), 639–647. https://doi.org/10.31004/edukatif.v4i1.1854

Rahmat, R. F., Mursyida, L., Rizal, F., Krismadinata, K., & Yunus, Y. (2019). Pengembangan media pembelajaran berbasis mobile learning pada mata pelajaran simulasi digital. *Jurnal Inovasi Teknologi Pendidikan*, *6*(2), 116–126. https://doi.org/10.21831/jitp.v6i2.27414

Risdiana Chandra Dhewy. (2022). PELATIHAN ANALISIS DATA KUANTITATIF UNTUK PENULISAN KARYA ILMIAH MAHASISWA. *J-ABDI: Jurnal Pengabdian Kepada Masyarakat*, *2*(3), 4575–4578. https://doi.org/10.53625/jabdi.v2i3.3224

Saputra, R., Susilawati, S., & Verawati, N. N. S. P. (2020). Pengaruh Penggunaan Media Simulasi Phet (Physics Education Technology) Terhadap Hasil Belajar Fisika. *Jurnal Pijar Mipa*, *15*(2), 110–115. https://doi.org/10.29303/jpm.v15i2.1459

Sar M., Rachman, H., Juli Astuti, N., Win Afgani, M., & Abdullah Siroj, R. (2022). Explanatory Survey dalam Metode Penelitian Deskriptif Kuantitatif. *Jurnal Pendidikan Sains Dan Komputer*, *3*(01), 10–16. https://doi.org/10.47709/jpsk.v3i01.1953

Saskia, R., Okuda, M., & Cooney, B. (2023). Utilization of Google From as a Quiz for Learning Fiqh. *Scientechno: Journal of Science and Technology*, *2*(1), 49–63. https://doi.org/10.55849/scientechno.v2i1.45

Sastradipraja, C. K. (2020). RANCANG BANGUN SIMULASI TOOL SISTEM AUDIT TEKNOLOGI INFORMASI BERBASIS WEB. *Jurnal Riset Sistem Informasi Dan Teknologi Informasi (JURSISTEKNI)*, *2*(1), 46–58. https://doi.org/10.52005/jursistekni.v2i1.38

Utami, L. D., Amin, M., Mustafiyanti, M., & Alon, F. (2023). Masjid Friendly: Mosque Based Economic Empowerment. *Pengabdian: Jurnal Abdimas*, *1*(2), 97–106. https://doi.org/10.55849/abdimas.v1i2.186

Wang, M., Li, Y., Cheng, Z., Zhong, C., & Ma, W. (2021). Evolution and equilibrium of a green technological innovation system: Simulation of a tripartite game model. *Journal of Cleaner Production*, *278*, 123944. https://doi.org/10.1016/j.jclepro.2020.123944