International Journal of Social Science and Human Research

ISSN (print): 2644-0679, ISSN (online): 2644-0695

Volume 07 Issue 09 September 2024

DOI: 10.47191/ijsshr/v7-i09-18**,** Impact factor- 7.876

Page No: 6869-6877

The Effect of Artificial Intelligence (AI) Based Learning Implementation on the Quality of Learning Outcomes of Vocational High School Students in the Field of Machining

Dessy Riski[1], Apri Nuryanto[2]

[1,2] Yogyakarta State University, Indonesia

ABSTRACT: The development of artificial intelligence (AI) technology has had a significant impact on various sectors, including education. The implementation of AI in the learning process is expected to improve the quality of student learning outcomes. AIbased learning offers various potentials to personalize learning, provide faster and more accurate feedback, and increase student motivation. However, the limited research on the effectiveness of AI in the context of vocational education, especially in the field of machining, prompted this study. This study used a quasi-experimental design with a pretest-posttest nonequivalent control group design. This research was conducted in two schools, namely State Vocational High School 2 Depok-Sleman and State Vocational High School 2 Yogyakarta. The subjects of this research of students in class X of Mechanical Engineering, each school will be randomly divided into two groups, namely the experimental group and the control group. The experimental group is a class that receives Artificial Intelligence-based learning and the control group is a class that receives conventional learning. The population in this study was 252 students. The sampling technique used cluster random sampling technique and obtained a research sample of 144 students. The research instruments used include pre-test or initial ability test, post-test or final test, and student response questionnaire. And additional data again using observation during the implementation of learning. The data obtained were analyzed using analysis of variance test (one-way ANOVA), Paired Sample t-Test test and Independent Sample tTest test. The results showed that (1) In the Independent Sample t-Test test, the significance level was <0.001, which means that there is a significant difference in the average value between the experimental group and the control group on the final learning outcomes. Students who received AI-based learning obtained an average post-test score of 81.18 while students who received conventional learning obtained an average post-test score of 76.26. (2) the results of the student response questionnaire showed that the majority of students in the experimental group gave a positive response to AI-based learning by obtaining an average percentage value for the metacognition aspect of 89% and the aspect of student activeness of 96%, they felt more motivated, easier to understand the material, and more active in the learning process using artificial intelligence.

KEYWORDS: Artificial Intelligence-Based Learning, Learning Outcomes, Vocational High School In Mechanical Engineering, Learning Effectiveness and Modern Technology.

I. INTRODUCTION

In the modern era like now, accessing all information is very easy with the presence of various kinds of technological machines that can simulate human intelligence easily and quickly. The emergence of big data, cloud computing, artificial neural networks, and machine learning, engineers can now create machines that can mimic human intelligence (Zhai et al., 2021). Artificial intelligence has been widely implemented in the world of education, such as intelligent tutoring systems, teaching robots, interaction between humans and computers, perplexity, GPT chat and so on (Chen, Xie and Hwang, 2020). Artificial Intelligence can provide a very significant change in the world of education, but good educational results are not only obtained from students or teachers using sophisticated AI computerized technology. Since its release in November 2022, the ChatGPT tool, created by OpenAI, has promised to be a replacement for internet search engines by not only finding information but also synthesizing and presenting it in a way that can be understood quickly (Ojeda et al., 2023). Artificial intelligence has met the criteria of success in growing substantially to make recommendations, a prediction or conjecture and provide something new in the field of education (Chen et al., 2022). In the current era, many students and teachers use Gadgets for daily life, both in communication, solving problems, relieving boredom, and so on. The implementation of artificial intelligence needs adequate digital infrastructure for the smooth use of AI. But in the world of education, there is often a limitation of access to artificial intelligence (AI) technology itself in schools. Teachers

still use conventional learning models such as repetitive lectures so that learning is carried out with one-way communication, namely teacher to student.

According to Nambatari et al., (2021) argue that teachers in the use of ICT media in the implementation of learning do not yet have a variety for a reason or several reasons, such as teachers facing difficulties in mastering modern learning media such as Artificial Intelligence. Artificial Intelligence-based learning assessment in the cluster has not been implemented due to the lack of mastery of the teaching staff at the school. When using technology such as learning media, students are more likely to become more active (Lumban Gaol & Simanjuntak, 2023). The successful implementation of technology-supported innovative learning is strongly influenced by the availability and quality of personal infrastructure owned by teachers and students. This infrastructure, in the form of adequate hardware and software, is a solid foundation for the realization of a creative and effective learning process. Without adequate infrastructure support, the potential of technology integration in learning cannot be optimally realized. Students who are not accustomed to using advanced technology such as artificial intelligence and teaching staff who do not receive adequate training become obstacles to maximizing the use of AI in the learning process.

The ability to master and apply modern vocational education, especially in the context of artificial intelligence as emphasized by Wu (2021). According to Dwivedi et al. (2021, p. 2) not only focuses on the immediate performance implications of artificial intelligence (AI), but also delves deeply into the far-reaching impacts and unforeseen consequences brought about by the development of this technology. AI-based learning has the ability to examine big data to determine the structure and distribution of knowledge, which is helpful for educators to make decisions because it relies on informed learning strategies and curriculum design. But it is often the case that students only use and utilize AI for a short period of time, when they already have the answers, students are reluctant to read and will switch to other activities such as playing games. The use of artificial intelligence should be monitored by evaluations given by teachers, to see how the use of AI is progressing. Students have not used AI for learning improvement, the evaluation given should also be relevant to the problems that often occur when using artificial intelligence. As a teacher, you can use AI to create the best learning plan or design for each student, identify the special needs of each student, and create learning that suits the student's learning ability. However, you must also ensure that the use of AI in education is done appropriately so that it does not cause any impact that can threaten education.

After knowing the reality in schools that most educators and students still do not know and are not familiar with the use of advanced technology such as artificial intelligence, there is no adequate digital training, the age factor of teaching staff is an obstacle to understanding artificial intelligence who already tend to teach in a traditional way, there is no integration of the use of artificial intelligence by students which will have a real impact on the use of artificial intelligence in the learning process. So from the explanation above, it gives encouragement to researchers to discuss the effect of the implementation of artificial intelligencebased learning on the quality of student learning outcomes. This study aims to (1) Analyze and identify the effect of the implementation of Artificial Intelligence in Basic Mechanical Engineering subjects on the quality of student learning outcomes. (2) Identify the advantages of Artificial Intelligence-based learning over conventional learning in terms of learning outcomes of grade X students of Mechanical Engineering at State Vocational High School 2 Depok-Sleman and State Vocational High School 2 Yogyakarta.

II. METHOD

This research uses quantitative research with experimental research methods. The experimental method used is quasi experimental design using nonequevalent control group design. The population in this study was carried out in class X of Mechanical Engineering in two schools, namely at State Vocational High School 2 Depok-Sleman and State Vocational High School 2 Yogyakarta. The number of students who became the population in this study was 252 students. Sampling technique: the sampling technique in this study used cluster random sampling technique. This technique provides opportunities for all populations to have the opportunity to become research samples.

Data analysis techniques in this study used descriptive analysis and prerequisite analysis tests and then hypothesis testing using the one-way ANOVA test, paired sample t-Test test and independent sample t-Test test. The prerequisite analysis test in this study uses a univariate normality test and a univariate homogeneity test. The one-way ANOVA hypothesis test was used to determine whether there was an average difference in the pre-test learning outcomes (before treatment) of the experimental group and control group. The paired sample t-Test hypothesis test was used to determine whether there was a significant difference between the pretest and posttest learning outcomes of each group. The independent sample t-Test was used to determine whether there was an effect of artificial intelligence-based learning on the quality of student learning outcomes. Analysis of prerequisite tests and hypothesis tests using IBM SPSS Version 29 software.

III. RESULT AND DISCUSSION A. RESULT 1. Pre-test and Post-test Exsperimental Class Table 1. Pre-test and Post-test Experimental Class

Pre-test			Post-test	
N	Valid	72	Valid	72
	Missing	0	Missing	0
Mean		65.17	Mean	81.18
Median		65.50	Median	82.00
Std. Deviation		9.203	Std. Deviation	7.898
Variance		84.704	Variance	62.375
Range		45	Range	36
Minimum		40	Minimum	61
Maximum		85	Maximum	97
Sum		4692	Sum	5845

It is known that the results of the experimental class pre-test calculation obtained the number of valid samples is 72, the average score = 65.17, the middle or median value = 65.50, the standard deviation = 9.20, range = 45, minimum value = 40 and maximum value = 85. It is known that the results of the experimental class post-test calculation obtained the number of valid samples is 72, the average score = 81.18, the middle or median value = 82, the standard deviation = 7.89, range = 36, minimum value = 61 and maximum value = 97.

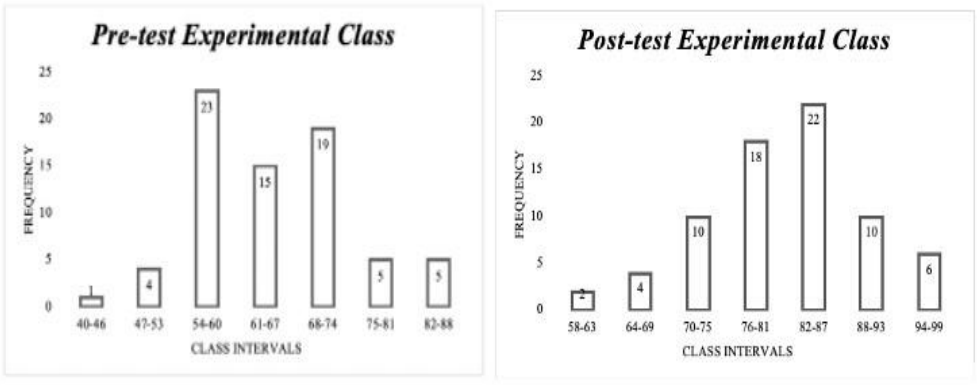
The frequency distribution of the results of the pre-test and post-test of the experimental class can be seen from the following table.

Table 2. Frequency Distribution

Pre-test			Post-test		
Class Intervals	**Frequency**	**Percentage**	**Class Intervals**	**Frequency**	**Percentage**
40-46	1	1.4%	58-63	2	2.8%
47-53	4	5.6%	64-69	4	5.6%
54-60	23	31.9%	70-75	10	13.9%
61-67	15	20.8%	76-81	18	25.0%
68-74	19	26.4%	82-87	22	30.6%
75-81	5	6.9%	88-93	10	13.9%
82-88	5	6.9%	94-99	6	8.3%
Total	**72**	**100%**	**Total**	**72**	**100%**

Based on the results of the frequency distribution table of the pre-test and post-test of the experimental class, it can be described more clearly and in detail in the chart below:

Table 3. Experimental Class Pre-test and Post-test Chart



Based on the chart above, the majority of the experimental class pre-test frequency results are in the 54-60 interval with 23 students (31.9%) and in the 68-74 interval with 19 students (26.4%). Based on the chart above, the experimental class post-test frequency results are mostly in the 82-87 interval with 22 students (30.6%) and in the 76-81 interval with 18 students (25%).

2. Pre-test and Post-test Control Class Table 4. Pre-test and Post-test Control Class

Pre-test			Post-test	
N	Valid	72	Valid	72
	Missing	0	Missing	0
Mean		65.71	Mean	76.26
Median		66.00	Median	77.00
Std. Deviation		8.109	Std. Deviation	6.160
Variance		65.759	Variance	37.943
Range		36	Range	25
Minimum		43	Minimum	63
Maximum		79	Maximum	88
Sum		4731	Sum	5491

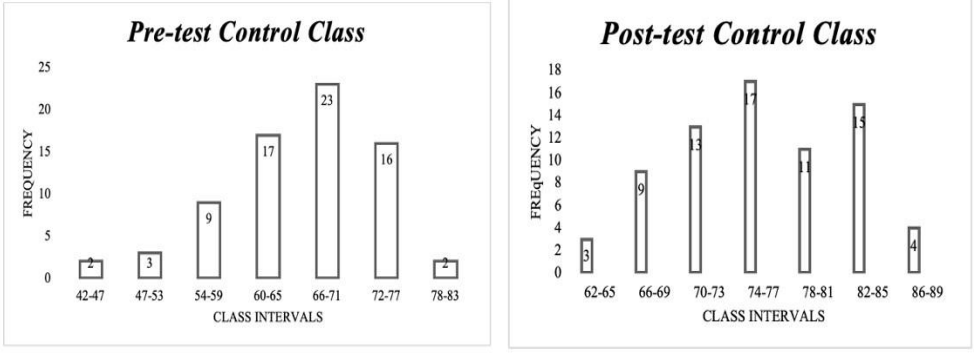
It is known that the results of the control class pre-test calculation obtained the number of valid samples is 72, the average score = 65.71, the middle or median value = 66, the standard deviation = 8.10, range = 36, minimum value = 43 and maximum value = 79. It is known that the results of the control class post-test calculation obtained the number of valid samples is 72, the average score = 76.26, the mean or median value = 77, the standard deviation = 6.16, range = 25, minimum value = 63 and maximum value = 88. The frequency distribution of the results of the pre-test and post-test of the control class can be seen from the following table.

Table 5. Frequency Distribution

Pre-test			Post-test		
Class Intervals	**Frequency**	**Percentage**	**Class Intervals**	**Frequency**	**Percentage**
42-47	2	2.8%	62-65	3	4.2%
48-53	3	4.2%	66-69	9	12.5%
54-59	9	12.5%	70-73	13	18.1%
60-65	17	23.6%	74-77	17	23.6%
66-71	23	31.9%	78-81	11	15.3%
72-77	16	22.2%	82-85	15	20.8%
78-83	2	2.8%	86-89	4	5.6%
Total	72	100%	**Total**	72	100%

Based on the results of the frequency distribution table of the pre-test and post-test of the control class, it can be described more clearly and in detail in the chart below:

Table 6. Control Class Pre-test and Post-test Chart



Based on the chart above, the majority of the control class pre-test frequency results are in the 66-71 interval with 23 students (31.9%) and in the 60-65 interval with 17 students (23.6%). Based on the chart above, the majority of the control class post-test frequency results are in the 66-71 interval with 23 students (31.9%) and in the 60-65 interval with 17 students (23.6%).

3. Normality Test Table 7. Normality Test Results

	Group	Sig.	Conclusion
Learning Outcomes	Pre-test exsperimental class	0.061	Normal
	Post-test exsperimental class	0.011	Normal
	Pre-test control class	0.046	Normal
	Pre-test control class	0.200	Normal

The normality test is a test conducted to test whether all research variables are normally distributed or not. The normality test uses the Kolmogorov-Smirnov formula because the number of samples > 30, if the number of samples < 30 then use the ShapiroWilk formula. This normal test decision is known if the value (sig > 0.05) then the data is normally distributed and if the value (sig < 0.05) then the data obtained is not normally distributed. The calculation results obtained are as follows:

The results of testing the normality of the data in the table above show that the significance value (sig) for both pre-test and post-test data in both research groups, namely the experimental class and the control class, is above the significance level of 0.05. This finding indicates that the assumption of data normality is met. Thus, we can continue data analysis using parametric statistical tests that require normally distributed data.

4. Homogeneity Test Table 8. Homogeneity Test Results

	Levene Statistic	Sign.	Conclusion
Before Treatment	1.712	0.193	Homogen
After Treatment	3.869	0.193	Homogen

The homogeneity test is a test used to see or determine the level of similarity of variance between two groups, namely from the learning outcomes after treatment (post-test) of the experimental group and control group. To know whether the data is homogeneous or not, the basis for making decisions in the homogeneity test is as follows:

- If the significance value (sig) on based on mean > 0.05, then the data is homogeneous
- If the significance value (sig) on based on mean < 0.05, then the data is not homogeneous

Based on the data results in the table above, it is known that the pre-test and post-test data for learning outcomes in both the experimental and control classes have a value of (sig> 0.05), it can be concluded that the pre-test and post-test data in the experimental or control class are homogeneous.

5. One Way ANOVA Test

One-Way ANOVA (one-way Analysis of Variance) test is a statistical technique used to test whether there is a significant difference between the means of two or more groups.

- If the p value is <0.05: $H_1$is rejected. That is, there is a significant difference between at least one pair of means.
- If the p value is ≥ 0.05$H_!$ is accepted. That is, there is insufficient evidence to suggest that there is a significant difference between the means.

Table 9. One-Way ANOVA Test Results

Learning Outcomes	f	Sig.
Pre-test	0.140	0.708

From the data calculated using IBM SPSS 29 software, it is known that the Sig value. (2-tailed) of 0.708, if divided by two the result is 0.354, where the value is> 0.05 then $H_!$ is accepted, it can be concluded that there is no average difference between student learning outcomes in basic mechanical engineering subjects before being treated (pre-test). This means that there is no difference in

the average pretest scores of students in the experimental class and control class. At the beginning of the study, both classes had relatively similar abilities.

6. Paired Sample t-Test Table 10. Paired Sample t-Test Results

Class	Group	Mean	Std. Deviation	Sig
Exsperimental	*Pre-test*	65.54	9.84	< 0.001
	Post-test	81.18	7.89	< 0.001
Control	*Pre-test*	65.71	8.10	< 0.001
	Post-test	76.26	6.10	< 0.001

From the data calculated using IBM SPSS 29 software, it is known that the Sig value. (2-tailed) of <0.001 which is <0.05, it can be concluded that there is a significant difference between the learning outcomes of the basics of mechanical engineering before being treated (pre-test) and after being treated (post-test).

7. Independent Sample t-Test Table 11. Independent Sample t-Test Results

Learning Outcomes After Treatment (*Post-test*)	Class	Mean	t	Std. Deviation	Sig. (2-tailed)
	Post-test Exsperimental	81.18	4.165	7.89	< 0.001
	Post-test Control	76.26		6.16	

Based on the table above, it is known that the results of the calculation data using IBM SPSS 29 software for the t value are 4.165 where t = 4.165> 0 and for the significance value of <0.001 (2-tailed must be divided by 2) Where if divided by two the results remain less than 0.05, then H_1 is rejected so that it can be concluded that the Artificial Intelligence-based learning model is superior to the conventional learning model in terms of the average value of student learning outcomes.

B. DISCUSSION

The hypothesis in this study is divided into 2 (two), namely: (1) There is an influence in the implementation of Artificial Intelligence in Basic Mechanical Engineering subjects on the quality of student learning outcomes, (2) Artificial Intelligencebased learning is superior to conventional learning in terms of student learning outcomes. Based on the results of the hypothesis that has been discussed in the previous sub-chapter, the results of calculations using IBM SPSS 29 software are obtained. The following is a detailed discussion of the results of the hypothesis analysis obtained.

1. There is an Influence in the Implementation of Artificial Intelligence in Basic Mechanical Engineering Subjects on the Quality of Student Learning Outcomes

The application of Artificial Intelligence-based learning aims to develop the quality of student learning outcomes through activities that have been planned or designed by the teacher in the groups formed. Heterogeneous group assignments consisting of 5-6 students per group. When the learning process begins, the teacher will distribute LKPD to each group. The subject taught is the basics of mechanical engineering on the elements of technological developments in industry and the world of work and global warming issues related to the world of machine manufacturing which are divided into four discussions, namely the development of manufacturing technology and the internet of things, digital technology in the industrial world, global warming issues in the world of machine manufacturing, and aspects of employment.

The calculation results obtained using IBM SPSS 29 software with the One-Way ANOVA test mean pretest in the experimental class of 65.54 and the control class of 65.71 and for a significant value of 0.708. Where the value is greater than 0.05 so that H_1 is accepted. Furthermore, for the average posttest score (after being treated) the experimental class score is superior to the control class.

The posttest value of the experimental class was 81.18 while the control class was 76.26 where the average value of the experimental class was above the average value of the control class. This is in line with research conducted by Muhammad Yahya, Hidayat, and Wahyudi (2023) that students who get artificial intelligence-based learning are better than students who get conventional learning. The learning device is declared effective because artificial intelligence-based learning activities seen from the performance of students in groups based on observations during the study reached 98%. It is known from the Student Worksheet

given to the experimental class and control class, the experimental class is more active and directed than the control class. Students who use artificial intelligence are more active because they utilize learning resources well.

For discussion, the experimental class used artificial intelligence, while the control class used a book or cellphone but did not access artificial intelligence. The teacher first explains the material to be presented, because the teacher acts as a facilitator in the class. Furthermore, when students finish discussing, the teacher will direct and facilitate one of the groups to present the results of their discussion to all classmates and for groups that have not advanced they will observe and give criticism or suggestions on the results of the group that is presenting. This is what makes artificial intelligence-based learning better.

Different from the experimental class, control class students tend to be inactive in the learning process in class. Students in the control class based on the results of observations during the study reached 95% less than students who received artificial intelligence-based learning. Student discussions with conventional learning were not as active as AI-based learning students. Many students were not active and did not ask what difficulties they experienced, there were only a few or some students who only asked questions. They look for information when they get the answer without understanding the concept of the question and the answer they get. This is in line with Feng Hui's research (2020) The use of interactive learning systems that utilize artificial intelligence can help students master the knowledge learned better, be more active, and change the traditional way of learning to be more effective and efficient.

2. Artificial Intelligence-Based Learning is Superior to Conventional Learning in terms of Student Learning Outcomes

The test of the effect of learning outcomes using the independent sample t-test obtained a t value of 4.165 where t = 4.165 > 0 and a significance value of < 0.001 (2-tailed) where if divided by 2 the value remains less than 0.05 then H_1 is rejected which means Artificial Intelligence-based learning is superior to conventional learning in terms of average learning outcomes.

The results of the independent sample t-test show a significant difference between the average learning outcomes of students using Artificial Intelligence (AI)-based learning and students using conventional learning. The calculated t value of 4.165 is greater than the t table value (which is usually assumed to be 2) and the significance value is much smaller than 0.05, both for two-sided (2-tailed) and one-sided tests. This indicates that the difference in average learning outcomes between the two groups did not occur by chance, but rather due to the influence of the learning method used. In other words, AI-based learning is proven to be more effective in improving the average student learning outcomes compared to conventional learning. The significant average difference, 81.18 for the experimental class (AI) and 76.26 for the control class, further strengthens this conclusion.

In the learning process, students who received Artificial Intelligence-based learning were more active than those who received conventional learning. In the implementation of learning during the study, the experimental class was superior to the control class. In the experimental class, at the end after the posttest, students were given a response questionnaire to learning using Artificial Intelligence. Aspects in the questionnaire are divided into 2, aspects of metacognition and student activeness. This is in line with the concept of metacognition, which is the awareness and self-control of the thinking process. Thus, AI-based learning not only increases students' engagement but also encourages them to become independent and responsible learners. The results of the percentage of student metacognition reached 89% and the activeness aspect was 96%. The largest percentage is in the activeness aspect of 96%.

This research provides strong evidence of the positive impact of Artificial Intelligence (AI)-based learning on student engagement and metacognition. The results showing the percentage of experimental class student activeness reaching 96% is a very good indicator. According to research by Khairul Marlin, et al. (2023) Learning using AI makes students more active and interacts directly with the teacher. This indicates that the integration of AI technology in the learning process succeeds in creating a more interactive and interesting learning environment for students. Adaptive features in AI, such as providing personalized feedback and adjusting the difficulty level of the material, allow each student to be actively involved in the learning process according to their individual abilities and pace.

In addition, the metacognition percentage of 89% also indicates that students learning with AI are better able to reflect on and regulate their own learning process. AI-based learning is often equipped with tools that help students monitor their learning progress, identify areas for improvement, and develop effective learning strategies. This is in line with the concept of metacognition, which is the awareness and self-control of the thinking process. Thus, AI-based learning not only increases students' engagement but also encourages them to become independent and responsible learners.

IV. CONCLUSION

Based on the results of research on the effect of artificial intelligence implementation on the quality of learning outcomes of students in class X of Mechanical Engineering at State Vocational High School 2 Depok-Sleman and State Vocational High School 2 Yogyakarta, the following conclusions can be drawn:

1. There is an influence in the implementation of Artificial Intelligence in Basic Mechanical Engineering subjects on the quality of learning outcomes of class X students of Mechanical Engineering at State Vocational High School 2 Depok-Sleman and State Vocational High School 2 Yogyakarta. The implementation of Artificial Intelligence (AI)-based learning in Basic Mechanical Engineering subjects has had a significant influence on the quality of learning outcomes of grade X Mechanical Engineering students

in both schools that are the object of research. This indicates that the integration of AI technology in the learning process is able to improve concept understanding, problem solving skills, and students' ability to apply the knowledge gained.

2. Artificial Intelligence-based learning is superior to conventional learning in terms of learning outcomes of grade X students of Mechanical Engineering at State Vocational High School 2 Depok-Sleman and State Vocational High School 2 Yogyakarta.

REFERENCES

1) Ahmad, S. F., Han, H., Alam, M. M., Rehmat, M. K., Irshad, M., Arraño-Muñoz, M., & Ariza-Montes, A. (2023). The Impact of Artificial Intelligence on Human Disadvantages in Decision Making, Laziness and Safety in Education. Humanities and Social Science Communication, 10(1), 311. Https://Doi.Org/10.1057/S41599-023-01787-8
2) Chen, L., Chen, P., & Lin, Z. (2020). Artificial Intelligence in Education: A Review. IEEE Access, 8, 75264-75278. Https://Doi.Org/10.1109/ACCESS.2020.2988510
3) Chen, Y. (2023). Evaluation of Teaching Methods of Fluid Mechanics Course in Engineering Education.
4) Doringin, F., Tarigan, N. M., & Prihanto, J. N. (2020). Education in the Era of the Industrial Revolution 4.0. Journal of Industrial Technology and Engineering (JTIR), 1(1), 43-48. https://doi.org/10.53091/jtir.v1i1.17
5) Djojonegoro, W. (1998). Development of Human Resources through Vocational Schools. Jayakarta Agung Offset.
6) Dwivedi, Y. K., Hughes, L., Ismagilova, E., Aarts, G., Coombs, C., Crick, T., Duan, Y., Dwivedi, R., Edwards, J., Eirug, A., Galanos, V., Ilavarasan, P. V., Janssen, M., Jones, P., Kar, A. K., Kizgin, H., Kronemann, B., Lal, B., Lucini, B., ... Williams, M. D. (2021). Artificial Intelligence (AI): Multidisciplinary Perspectives on Challenges, Opportunities, and Emerging Agendas for Research, Practice, and Policy. International Journal Of Information Management, 57, 101994. Https://Doi.Org/10.1016/J.Ijinfomgt.2019.08.002
7) Etistika Yuni Wijaya, Dwi Agus Sudjimat, & Amat Nyoto. (2016). Transformation of 21st Century Education as a Demand. Journal of Education, 1, 263-278. http://repository.unikama.ac.id/840/32/263-278 21st Century Education Transformation as a Demand for Human Resource Development in the Global Era .pdf. accessed on; day / date; Saturday, November 3, 2018. hour; 00:26, wib.
8) Hoedi Prasetyo1, W. S. (2018). The British Empire: A Study of Colonial Geography. Journal of Industrial Engineering, 66(4), 372. https://doi.org/10.2307/1782970
9) Hui, F. (2020). Impact of Artificial Intelligence on Vocational Education and its Countermeasures. Journal of Physics: Conference Series, 1693(1), 012124. Https://Doi.Org/10.1088/1742-6596/1693/1/012124
10) Hwang, G.-J., & Chien, S.-Y. (2022). Definition, Role, and Potential Research Issues of the Metaverse in Education: An Artificial Intelligence Perspective. Computers and Education: Artificial Intelligence, 3, 100082. Https://Doi.Org/10.1016/J.Caeai.2022.100082
11) Khalid, M. (2023). Contextual Variations on Teachers' Conceptions of ICT-enhanced Teaching in Engineering Education.
12) Khosravi, H., Shum, S. B., Chen, G., Conati, C., Tsai, Y.-S., Kay, J., Knight, S., Martinez-Maldonado, R., Sadiq, S., & Gašević, D. (2022). Explainable Artificial Intelligence in Education. Computers And Education: Artificial Intelligence, 3, 100074. Https://Doi.Org/10.1016/J.Caeai.2022.100074
13) Lase, D. (2019). Education in the Era of Industrial Revolution 4.0. SUNDERMANN: Scientific Journal of Theology, Education, Science, Humanities and Culture, 12(2), 28-43. https://doi.org/10.36588/sundermann.v1i1.18
14) Lumban Gaol, C. A., & Simanjuntak, S. (2023). Analysis of Teacher Difficulties in Applying Technology in the Learning Process at SD Negeri 08 Bilah Hilir Labuhan Batu T.A 2022/2023. Journal On Education, 6(1), 2441-2448. Https://Doi.Org/10.31004/Joe.V6i1.3267
15) Martínez-Comesaña, M., Rigueira-Díaz, X., Larrañaga-Janeiro, A., Martínez-Torres, J., Ocarranza-Prado, I., & Kreibel, D. (2023). Impacto de la inteligencia artificial en los métodos de evaluación en la educación primaria y secundaria: revision sistemática de la literatura. Revista De Psicodidáctica, 28(2), 93-103. Https://Doi.Org/10.1016/J.Psicod.2023.06.001
16) Maufidhoh, I., & Maghfirah, I. (T.T.). ABUYA: Journal of Basic Education.
17) Muhammad Yahya, Wahyudi, & Akmal Hidayat. (2023). Implementation of Artificial Intelligence (Ai) in the Field of Vocational Education in the Era of the Industrial Revolution 4.0. 62nd Anniversary National Seminar, 1, 190-199. Https://Doi.Org/10.59562/Semnasdies.V1i1.794
18) Nambatari, G. A. E., Zain, M. I., & Rosyidah, A. N. K. (2021). Analysis of the Level of Teacher Difficulty in Information and Communication Technology (Tik) Based Learning during the Covid-19 Pandemic in Sdn Gugus Iii Mataram. 3(1).
19) Noviansah, A. (2020). Assessment Objects, Knowledge, Attitudes, and Skills. 1.
20) Ojeda, A. D., Solano-Barliza, A. D., Alvarez, D. O., & Cárcamo, E. B. (2023). Análisis Del Impacto De La Inteligencia Artificial Chatgpt En Los Procesos De Enseñanza Y Aprendizaje En La Educación Universitaria. Formación Universitaria, 16(6), 61-70.

21) Ouyang, F., & Jiao, P. (2021). Artificial Intelligence In Education: The Three Paradigms. Computers And Education: Artificial Intelligence, 2, 100020. Https://Doi.Org/10.1016/J.Caeai.2021.100020
22) Permatasari, C. R. I., & Yunianta, T. N. H. (2021). E-Learning Artificial Intelligence as a Supplement in the Metacognitive Scaffolding Process of Integral Problem Solving. Axiom: Journal of Mathematics Education Study Program, 10(2), 829. Https://Doi.Org/10.24127/Ajpm.V10i2.3490
23) Putrawangsa, S., & Hasanah, U. (2018). Integration of Digital Technology in Learning in the Industry 4.0 Era. Tatsqif Journal, 16(1), 42-54. https://doi.org/10.20414/jtq.v16i1.203
24) Putri, V. A., Andjani, K. C., & Rafael, R. A. (2023). The Role of Artificial Intelligence in the Student Learning Process at Surabaya State University.
25) Saputra, T. (2023). The Role of Artificial Intelligence Chatgpt in Learning Planning in the Era of the Industrial Revolution 4.0. 3.
26) Saringat, M. Z. B., & Koesdijarto, R. (T.T.). Utilization of Artificial Intelligence (Ai) as a Response to Student Learning Style.
27) Syamsuar, S., & Reflianto, R. (2019). Education and the Challenges of Information Technology-Based Learning in the Era of the Industrial Revolution 4.0. E-Tech: Scientific Journal of Educational Technology, 6(2). Https://Doi.Org/10.24036/Et.V2i2.101343
28) Trilling, B., & Fadel, C. (2009). Bernie Trilling, Charles Fadel-21st Century Skills_ Learning for Life in Our Times Jossey-Bass (2009). Journal of Sustainable Development Education and Research, 2(1), 243.
29) Widyanto, I. P., & Wahyuni, E. T. (2020). Implementation of Learning Planning. 04(02).
30) Wildan, W. (2017). Implementation of Authentic Assessment of Knowledge, Attitude and Skills Aspects in Schools or Madrasahs. Tatsqif Journal, 15(2), 131-153. Https://Doi.Org/10.20414/Jtq.V15i2.3
31) Wu, X. (2021). Application Of Artificial Intelligence In Modern Vocational Education Technology. Journal Of Physics: Conference Series, 1881(3), 032074. Https://Doi.Org/10.1088/1742-6596/1881/3/032074
32) Zhai, X., Chu, X., Chai, C. S., Jong, M. S. Y., Istenic, A., Spector, M., Liu, J.-B., Yuan, J., & Li, Y. (2021). A Review Of Artificial Intelligence (AI) In Education From 2010 To 2020. Complexity, 2021, 1-18. Https://Doi.Org/10.1155/2021/8812542
33) Zhang, Y., Balochian, S., Agarwal, P., Bhatnagar, V., & Housheya, O. J. (2014a). Artificial Intelligence And Its Applications. *Mathematical Problems In Engineering*, *2014*, 1–10. Https://Doi.Org/10.1155/2014/840491
34) Zhang, Y., Balochian, S., Agarwal, P., Bhatnagar, V., & Housheya, O. J. (2014b). Artificial Intelligence And Its Applications. *Mathematical Problems In Engineering*, *2014*, 1–10. Https://Doi.Org/10.1155/2014/840491