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THE INFLUENCE OF DIGITAL LITERACY OF EDUCATORS BASED ON ARTIFICIAL INTELLIGENCE (AI) ON LEARNING EFFECTIVENESS AND EDUCATOR PERFORMANCE

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Abstrack:
This study examines the effect of digital literacy of educators based on Artificial Intelligence (AI) on learning effectiveness and educator performance in the Non-Formal Education Unit of the Learning Activity Center (SKB) in Pekalongan Prefecture. This research is quantitative causal research. With a population of 132 educators and a sample of 101 educators using a simple random sampling, data were collected through questionnaires and analyzed descriptively and simple linear regression. The findings indicated that the digital literacy of AI-based educators positively and significantly influenced learning effectiveness (59.1%) and educator performances (54%), with a significance value of 0.000 <0.005. The research conclusion emphasizes the importance of improving digital literacy through training and collaboration and the need for support from agencies and the government in providing access to technology and adequate infrastructure. Future investigations will examine additional independent variables that could impact educational outcomes.

Keyword : Educator Digital Literacy; Artificial Intelligence (AI); Learning Effectiveness; Educator Performance

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Introduction

In the 21st century, having literacy skills is very important in life. Rapid advances in science, technology, and information require human literacy skills to continue developing and adapting. Therefore, we must continue learning and improving literacy Hardiyanti & Alwi (2022). In 2022, the Ministry of Communication and Information Technology (Kemenkominfo), in collaboration with the Katadata Insight Center, announced an increase in Indonesia's digital literacy index to 3.54. This figure is higher than the previous year's, reaching only 3.49. However, despite the increase, as quoted from CNBC Indonesia (2023), according to Aviliani, a senior economist from INDEF, Indonesia still has a low degree of digital literacy compared to other ASEAN nations compared to other ASEAN nations. This shows that although many Indonesians are already technologically literate, their ability and skills still vary. Meanwhile, proficiency in digital literacy is required in many domains, including education Aini & Nuro (2023).

The condition of low digital literacy is caused by various factors, such as the condition of access and infrastructure, individual and social, to support and policies from the government as well as support from units and leaders. Educators, as one of the tools in every educational unit, are expected to have digital literacy skills that are not only good but also adequate. The ability of educators to use information and communication technology in the teaching and learning process is what digital literacy means in this context. This skill is crucial for overcoming various new challenges in the constantly changing field of education. Educators have an essential role in optimizing the use of information and communication technology, especially in accessing the Internet to manage the educational process and quality learning materials to support the development of students. Educators

must creatively utilize technology to find quality learning resources and manage more interactive learning.

One of the most significant technological developments is the existence of Artificial Intelligence (AI). AI is now an important part of teaching and learning activities in schools and universities (Mulianingsih et al., 2020). Through this AI technology, schools can utilize applications that can automate various tasks, such as feedback, selection of learning materials, and personalization of learning according to the needs of each student (Hakim, 2022).

However, this technology has yet to be fully utilized in learning. There are still several educational institutions that still need to adopt technology in the learning process. Today's academic institutions need to use technological developments to facilitate the tasks of educators and students. It is time for all schools to start using technology in learning (Tjahyanti et al., 2022). Education units still need to utilize artificial intelligence (AI) technology in the learning process and face several challenges, such as the lack of adequate educators' understanding of AI technology and limited access to technological resources.

However, it is still critical to pursue digital literacy because it is the key to preparing for future challenges. Only now have a few studies examined educators' digital literacy, especially for educators in non-formal education units. So this research is essential to do in order provide a deeper understanding of the extent to which the digital literacy of educators based on Artificial Intelligence (AI) can affect the effectiveness of learning and the performance of educators in the non-formal education unit Sanggar Kegiatan Belajar (SKB). In the future, this research can also be a basis for developing policies and training programs to improve educators' digital competence, which can improve the overall quality of education.

Research Method

This type of research is quantitative research. According to Sugiyono [16], a causal quantitative approach is a research method used to identify cause-and-effect relationships between two or more variables. This research is included in causal quantitative research because it aims to determine the effect of digital literacy on educators based on artificial intelligence (AI) (X) on learning effectiveness (Y1) and educator performance (Y2).

The population used in this study were educators (Teachers and tutors) in the Non-formal Education Unit of the SKB in the Pekalongan Prefecture of Central Java Province consisting of SKB Pekalongan Regency, SKB Pekalongan City, SKB Tegal Regency, SKB Tegal City, SKB Brebes Regency, SKB Pemalang Regency, and SKB Batang Regency totaling 132 educators. Sampling was carried out using the Simple Random Sampling technique, totaling 101 educators with the following calculations:

Table 1. Overview of the Study Population and Sample

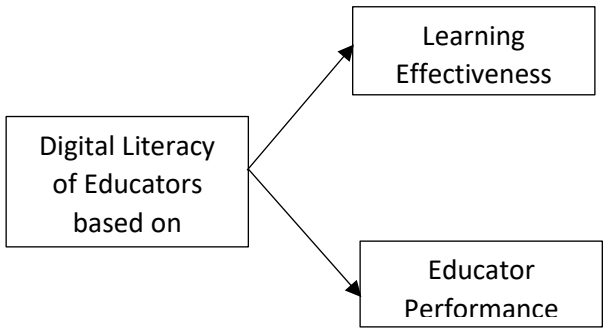
NO	REGION/SKB	POPULATION	CONSIDERATIONS	SAMPLE
1	SKB Pekalongan Regency	16	$\frac{16}{132} x\ 99$ = 12	12
2	SKB Pekalongan City	18	$\frac{18}{132} x\ 99$ = 13,5	14
3	SKB Tegal Regency	23	$\frac{23}{132} x\ 99$ = 17,25	18
4	SKB Tegal City	25	$\frac{25}{132} x\ 97$ = 18,75	19
5	SKB Pemalang Regency	21	$\frac{21}{132} x\ 99$ = 15,75	16
6	SKB Brebes Regency	13	$\frac{13}{132} x\ 99$ = 9,55	10
7	SKB Batang Regency	16	$\frac{16}{132} x\ 99$ = 12	12
Total		**132**		**101**

Source: Information from each SKB unit

A questionnaire was employed as part of the data collection method and distributed via *Google Form*s. The questionnaire used in this study is a type of closed questionnaire. The questionnaire used is a Likert scale using a 1-5 scale calculation, namely Strongly Agree (SS), scored 5; Agree (S), scored (4); Undecided (RG), scored 3; Disagree (TS), scored 2: Strongly Disagree (STS), score 1. Each score obtained has an ordinal measurement level (Sappaile, 2007)

Data testing is done with validity tests, reliability tests, descriptive statistical analysis, and classical assumption tests. Two classic assumption tests are the normality test and the heteroscedasticity test. The analytical tools used are Simple Regression Analysis and the coefficient of determination test.

Conceptual Framework



Visual Representation (Conceptual Framework Diagram)

Digital Literacy of Educators (central variable): This is the independent variable. It directly influences both Learning Effectiveness and Educator Performance. Learning Effectiveness (Mediating Variable): This variable acts as a mediator in enhancing educator performance based on their ability to use digital tools effectively. Educator Performance (Dependent Variable): The outcome variable is influenced by the level of digital literacy and the resulting learning effectiveness.

Research Implications

This framework can be used to Assess Educator Needs, Identify gaps in digital literacy, and target training programs. Policy Development can guide institutions in integrating technology into teaching practices. Performance Evaluation can develop metrics to evaluate the impact of digital literacy on learning outcomes and educator performance.

RESULT AND DISCUSSION

Descriptive Analysis of AI-Based Educator Digital Literacy Variables

Table 2. Descriptive Statistics of Digital Literacy of AI-Based Educators

Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
Digital Literacy of AI-Based Educators	101	36.00	100.00	76.4158	11.14295
Valid N (listwise)	101				

Source: SPSS 27 output, research data processing 2024

Table 3. Frequency Distributions of AI-Based Educator Digital Literacy Variables

No	Scor Interval	Total	Percentage	Category	Average
1	84 – 100	32	31,68%	Very High	76,4158
2	68 – 83	53	52,47%	High	
3	52 – 67	15	14,86%	High Enough	
4	36 – 51	1	0,99%	Low	

5	20 – 35	0	0	Very Low	
	Total	**101**	**100%**		**High**

Source: Research data processed in 2024

Table 4. Frequency Distribution of AI-based Educators' Digital Literacy Indicators

No	Indicator	Average	Category
1	Access	7,95	High
2	Selecting	8,01	High
3	Understanding	8,06	High
4	Analyzing	8,52	Very High
5	Verifying	7,14	High
6	Evaluate	7,45	High
7	Distribute	7,78	High
8	Producing	8,19	High
9	Participate	6,54	High Enough
10	Collaborate	6,72	High Enough

Source: Research data processed in 2024

These findings indicate that, among the 101 respondents, the highest value of the AI-based educator digital literacy variable is 100, and the lowest is 36 from the questions given. The standard deviation is 11.14295, and the mean value obtained on the variable is 76.4158. these descriptive statistics show that the mean value is above the standard deviation, indicating a good representation of the overall data. This means that educators at SKB in the Pekalongan Prefecture already have digital literacy based on artificial intelligence (AI), as indicated by the average result of AI-based educators, which is 76.4158 in the high category.

Descriptive Analysis of Learning Effectiveness Variables

Table 5. Descriptive Statistics of Learning Effectiveness

Descriptive Statistics

	N	Min	Max	Mean	Std. Deviation
Learning Effectiveness	101	22.00	75.00	60.2178	8.79841
Valid N (listwise)	101				

Source: SPSS 27 output, research data processing 2024

Table 6. Frequency Distribution of Learning Effectiveness Variables

No	Score Interval	Total	Percentage	Category	Average
1	63 - 75	32	31,68%	Highly Effective	
2	51 – 62	53	52,48%	Effective	
3	39 – 50	15	14,85%	Effective Enough	60,2178
4	27 – 38	0	0%	Less Effective	
5	15 – 26	1	0,99%	Very Less Effective	
	Total	**101**	**100%**		**Effective**

Source: Research data processed in 2024

Table 7. Frequency Distribution of Learning Effectiveness Indicators

No	Indicator	Average	Category
1	Learning Implementation Management	12,22	Effective
2	Communicative Process	12,15	Effective
3	Learner Response	12,02	Effective
4	Learning Activity	12,03	Effective
5	Learning Outcomes	11,78	Effective

Source: Research data processed in 2024

Based on the results, it is known that out of 101 respondents, the highest value of the learning effectiveness variable is 75, and the lowest value is 22 from the 15 questions given. The standard deviation is 8.79841, and the mean value obtained on the variable is 60.2178. The results of the descriptive statistics show that the mean value is greater than the standard deviation value, indicating a good representation of the overall data. This means that, in general, the effectiveness of learning at SKB in Pekalongan is at a practical level, indicated by the average result of learning effectiveness of 60.2178 in the helpful category.

Descriptive Analysis of Educator Performance Variables

Table 8. Descriptive Statistics of Educator Performance

	Descriptive Statistics				
	N	Min	Max	Mean	Std. Deviation
Educator Performance	101	21.00	75.00	61.5446	8.79264
Valid N (listwise)	101				

Source: SPSS 27 output, research data processing 2024

Table 9. Frequency Distribution of Educator Performance Variables

No	Scor Interval	Total	Percentage	Category	Average
1	63 – 75	27	26,73%	Very High	
2	51 – 62	63	62,37%	High	
3	39 – 50	10	9,91%	High Enough	61,5446
4	27 – 38	0	0	Low	
5	15 – 26	1	0,99%	Very Low	
Total		**101**	**100%**		**High**

Source: Research data processed in 2024

Table 10. Frequency Distribution of Educator Performance Indicators

No	Indicator	Average	Category
1	Quality of Work	12,22	High
2	Speed or Accuracy of Work	12,36	High
3	Initiative in Work	12,35	High
4	Employability	12,26	High
5	Communication	12,23	High

Source: Research data processed in 2024

Based on these results, out of 101 respondents, the highest value of the learning effectiveness variable was 75, and the lowest value was 21 from the 15 questions given. The standard deviation is 8.79264, and the mean value obtained on the variable is 61.5446. The results of the descriptive statistics of the overall data. This means that, in general, the performance of educators at SKB in Pekalongan is in the high category, indicated by the average result of educator performance of 61.5445 in the high category.

Normality Test Results

Table 11. Normality Test Results

Variables	Sig.	Decision
X > Y1	0.080	Normal
X > Y2	0.200	Normal

Source: Research data processed in 2024

According to the findings of the Kolmogrov-Smirnov normalcy test in the table above, the probability value p or Asymp. Sig. (2-tailed) on X against Y1 is 0.080 while on X against Y2 is 0.200. The normalcy assumption has been met because the probability value is above the 0.05 significance level.

Heteroscedasticity Test

Table 12. Heteroscedasticity Test Results

X > Y1		X > Y2	
Variables	**Sig.**	**Variables**	**Sig.**
Digital Literacy of AI-based Educators	0.405	Digital Literacy of AI-Based Educators	0.886

Source: Research data processed in 2024

Based on Table 12, the probability value (Sig) of the AI-based Educator Digital Literacy variable on Learning Effectiveness is 0.405, while the AI-based Educator Digital Literacy variable on Education Performance is 0.886. Since every variable's probability value (Sig) is above the significance level of 0.05 or 5%, it can be inferred that there are no signs of heteroscedasticity as the homoscedasticity assumption is met.

Simple Linear Regression Analysis

Table 13. Hasil Analisis Regresi Linear Sederhana

X > Y1		X > Y2	
Variable	**B**	**Variable**	**B**
Constant	13.852	Constant	17.226
Digital Literacy of AI-Based Educators	0.607	Digital Literacy of AI-Based Educators	0.580

Source: Research data processed in 2024

According to the findings of the above table's basic linear regression analysis, the regression model for the effect of AI-based Educators' Digital Literacy on Learning Effectiveness is obtained as follows:

$$Y = 13.852 + 0.607X$$

Where:
Y = Learning Effectiveness
X = Digital Literacy of AI-Based Educators

The following information is obtained based on the simple linear regression model above.

1. The constant is 13.852, which means that if the value of the independent variable (Digital Literacy of AI-Based Educators) does not change, then the value of the dependent variable (Learning Effectiveness) is also 13.852.
2. The regression coefficient on the AI-based Educator Digital Literacy variable is 0.607. It is positive, meaning that if the AI-based educator Digital Literacy variable increases by 1 point significantly, the AI-based Educator Digital Literacy variable will increase the value of the Learning Effectiveness variable by 0.607.

Meanwhile, the results of the regression model for the effect of AI-based Educator Digital Literacy on Educator Performance are as follows:

$$Y = 17.226 + 0.580X$$

Where:
Y = Educator Performance
X = Digital Literacy of AI-Based Educators

The following information is obtained based on the simple linear regression model above.

1. The constant is 17.226, which means that if the value of the independent variable (Digital Literacy of AI-Based Educators) does not change, then the value of the dependent variable (Educator Performance) is 17.226.
2. The regression coefficient on the AI-Based Educator Digital Literacy variable is 0.580 and positive, meaning that if the AI-Based Educator Digital Literacy variable increases by 1 point significantly, the AI-Based Educator Digital Literacy variable will increase the value of the Educator Performance variable by 0.580.

Coefficient of Determination

Table 14. Coefficient of Determination Results

Variables	*R Square*
Digital Literacy of AI-Based Educators on Learning Effectiveness	*0.591*
Digital Literacy of AI-Based Educators on Educator Performance	*0.540*

Source: Research data processed in 2024

Considering the outcomes of the previously mentioned coefficient of determination test, The regression model's R2 (R Square) value is used to calculate how well the independent variable (independent) can explain the dependent variable (dependent). Considering Table 14, it is known that the R value2 on the effect of AI-Based Educator Digital Literacy on Learning Effectiveness is 0.591, 59.1% of the variance in the dependent variable; according to this, Learning Effectiveness can be explained by variations in the independent variable, specifically AI-Based Educator Digital Literacy. While the remaining amount (100%-59.1% = 40.1%) is affected by factors not included in this study.

The effect of AI-Based Educator Digital Literacy on Educator Performance is 0.540. This means that 54% of the variation in the dependent variable, Educator Performance, can be explained by the variation in the independent variable, namely AI-Based Educator Digital Literacy. The remaining amount (100%-54% = 46%) is affected by factors not included in this study.

Research Hypothesis Test
T Test (Partial)

Table 15. Partial Test Result

X > Y1		X > Y2	
T Statistic	**Sig.**	**T Statistic**	**Sig.**
11.948	0.000	10.785	0.000

Source: Research data processed in 2024

Considering the findings of the t-test, presented in Table 15, it is obtained that the significant value of the AI-based Educator Digital Literacy variable is 0.000, which is less than 0.05. As for the t count, the value is 11.948> t table (1.983), so the AI-Based Educator Digital Literacy variable affects the Learning Effectiveness variable. So, the first hypothesis, H1: Digital Literacy of AI-Based Educators, has a positive and significant effect on the learning effectiveness variable, which is "accepted."

While the effect of AI-Based Educator Digital Literacy on Educator Performance has a significance value of 0.000, this value is smaller than 0.05. As for the t count, the value is 10.785>t table (1.983), so the AI-Based Educator Digital Literacy variable affects the Educator Performance variable. Thus, the second hypothesis, H2: Digital Literacy of AI-Based Educators has a positive and significant effect on the Educator Performance variable "accepted."

Discussion

The Influence of Digital Literacy of Educators Based on Artificial Intelligence (AI) on Learning Effectiveness

The study's first hypothesis is that teachers' digital literacy, which is based on artificial intelligence (AI), significantly improves the efficacy of learning. Considering the findings of the conducted research, the hypothesis is proven. The results of this study indicate that the digital literacy of educators based on Artificial Intelligence (AI) has a positive effect with a regression coefficient of 0.607, t count obtained a value of 11.948> t table (1.983) and significance with a significance value of 0.000 smaller than 0.005 on learning effectiveness. In light of these findings, the first hypothesis in this study is accepted. The accepted hypothesis means that the higher the digital literacy of educators based on Artificial Intelligence (AI), the more effective learning effectiveness SKB in the Pekalongan Prefecture of Central Java Province.

Descriptive statistical analysis of digital literacy of AI-based educators proves that the average value is included in the high category, namely 76.4158. High digital literacy of AI-based educators will also impact effective learning effectiveness because the digital literacy of AI-based educators affects learning effectiveness. The AI-based educator digital literacy variable is measured using ten indicators: accessing, selecting, understanding, analyzing, verifying, evaluating, distributing, producing, participating, and collaborating. Based on the outcomes of descriptive statistics, the indicator of analyzing is included in the very high category, the indicators of accessing, selecting, understanding, verifying, evaluating, distributing, and producing are included in the high category, and the indicators of participating and collaborating are included in the moderate category.

Considering the explanation, it is likely that the digital literacy of educators based on artificial intelligence (AI) impacts the effectiveness of learning. Educators with high AI-based digital literacy can use their ability to process data, analyze information, create more personalized and relevant learning content, and network to gain a more comprehensive experience. Therefore, the higher digital literacy of AI-based educators will encourage educators to continue to innovate in learning, increase the expectations of education, and increase student learning outcomes to face challenges in the digital era.

The findings of this study are consistent with Ulandari's (2023) statement that one role of AI is to increase human intellectual capacity and support a more effective and efficient learning process. So, if educators can utilize AI technology, it becomes one of the determining factors in how learning can be carried out more effectively.

Earlier research that supports the findings of this study on the effect of digital literacy on learning effectiveness is research from Sri Purwati & Sukiman (2024): Sukardi S. et al. (2023); Mukaromah & Wardoyo (2022), which shows the results that educators' digital literacy positively and significantly impact the quality of learning.

The Influence of Digital Literacy of Educators Based on Artificial Intelligence (AI) on Educator Performance

The study's second hypothesis is that teachers' digital literacy, based on artificial intelligence (AI), significantly and favorably affects their performance. Based on the results of the research that has been done, this hypothesis is proven. The results of this study indicate that the digital literacy of educators based on Artificial Intelligence (AI) has a positive effect with a regression coefficient of 0.508, the calculated t value obtained a value of 10,785> t table (1,983) and significance with a significance value of 0.000 smaller than 0.005 on educator performance.

Based on these results, the second hypothesis in this study can be accepted. The accepted hypothesis means that the higher the digital literacy of educators based on Artificial Intelligence (AI), the higher the performance of educators at SKB in the Pekalongan Prefecture of Central Java Province.

Therefore, the digital literacy of educators based on Artificial Intelligence (AI) impacts educator performance. Educators with high AI-based digital literacy can utilize AI technology to improve the quality of learning, such as developing more innovative learning materials, providing more personalized and immediate feedback to learners, and initiating the use of various AI tools in the learning process. This is reflected in improved quality of work, speed in responding to technological developments, and higher initiative in implementing innovations in learning. The higher the digital literacy of AI-based educators, the higher their performance.

The results of this study are those stated by Faizah (2019), that performance is the result achieved from an activity or job. In the context of education, the success of an educator in achieving institutional goals is primarily determined by his ability to teach. The ability to teach when supported by the digital literacy of AI-based educators will encourage educators to innovate in teaching and adapt to technological developments to integrate them into learning.

Previous research on the effect of digital literacy on educator performance, based on the results of this study, is from Ahyani et al. (2024), Kumalasari et al. (2023), and Sulistyarini & Fatonah (2022). This research shows that educators' digital literacy positively and significantly affects teacher performance and pedagogical competence.

CONCLUSION

From the study results, the digital literacy of AI-based educators has a positive and significant effect on learning effectiveness, and the digital literacy of AI-based educators has a positive and significant impact on educator performance. The suggestions that can be given are: (1) educators can improve digital literacy, primarily based on Artificial Intelligence (AI), by proactively participating in training and applying it in daily learning; (2) educators can also always collaborate with colleagues for various knowledge and experiences, (3) institutions need to provide easy access to technological devices and digital resources that support the use of AI and need to create an innovative learning culture and encourage educators to continue to develop themselves, (4) the government needs to facilitate the development of educator's digital literacy and provide adequate infrastructure as well as making policies that support the use of AI in education. (5) future research is expected to develop other independent variables that may affect learning effectiveness and educator performance. Because of the coefficient of determination analysis results in this study, the independent variables were able to explain the dependent variable by 59.1% and 54%. This means that other factors still affect the effectiveness of learning and educator performance by 40.1% and 46%.

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