Artificial Intelligence Literacy Levels Identified Among Elementary School Teachers in Magelang

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Abstract. General Background: Artificial intelligence literacy has become increasingly important in education, particularly as schools integrate AI and coding into formal curricula. Specific Background: In the context of implementing the Coding and Artificial Intelligence Curriculum (KKA) for the 2025/2026 academic year, elementary school teachers are required to possess adequate AI literacy encompassing conceptual, technical, and ethical understanding. Knowledge Gap: However, there is limited empirical evidence describing teachers' AI literacy levels and the contributing factors within the framework of AI literacy and cognitive domains. Aims: This study aims to analyze the level of AI literacy among elementary school teachers in Magelang Regency and examine factors associated with their literacy levels. Results: Using a quantitative approach with descriptive and multiple linear regression analyses, data from 68 teachers across 10 schools indicate that AI literacy is moderately high (mean = 3.57), with strongest performance in remembering (3.92) and understanding (3.87), while applying (3.32), evaluating (3.37), creating (3.42), and analyzing (3.51) require further development. Regression results show that attitudes and values toward AI ($\beta = 0.497$), educational level ($\beta = 0.689$), and experience in AI training ($\beta = 0.570$) are significant predictors of AI literacy. Novelty: This study integrates the AI Literacy Framework and Bloom's revised taxonomy to assess teachers' readiness for AI-based education. Implications: The findings highlight the need for continuous professional development focusing on cognitive and practical competencies to support effective implementation of AI-driven curricula in elementary education.

Keywords: Artificial intelligence literacy; Elementary school teachers; AI education curriculum; Bloom taxonomy; Teacher professional development

1 Introduction

The discourse on implementing coding and AI subjects was first conveyed by the Vice President of the Republic of Indonesia, Gibran Rakabuming Raka, at the Heads of

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Education Offices Coordination Meeting on Education Policy Evaluation in November 2024. Gibran asked elementary and junior high school students to be equipped with coding lessons, with the hope that a golden Indonesia could truly be achieved through the fulfillment of many experts, including those in coding and machine learning [1].

The Minister of Primary and Secondary Education (Mendikdasmen), Abdul Mu'ti, confirmed that coding and Artificial Intelligence (AI) will be elective subjects in schools starting in the 2025/2026 academic year for elementary school students in Phase C (grades 5 and 6) and junior high schools. These two subjects are part of the Ministry's efforts to build a superior generation, especially in terms of mastering technology for positive things. Coding and AI will be the first steps for Indonesian children to master technology. These two subjects will support the development of student literacy and numeracy. Not all schools will offer coding and AI subjects, but only those that are prepared, both in terms of having good internet facilities and adequate learning tools. Mu'ti hopes this step will be supported by other ministries, especially the Ministry of Communication and Digital [1].

AI has great potential to support the teaching and learning process, but it is crucial to emphasize that its use must be targeted and aligned with other learning methods. Teachers must guide the use of AI, as they possess a deeper understanding of the subject matter. This is because AI has several weaknesses. AI can be accessed quickly and easily, but students can obtain incorrect information from it, which can also contribute to their reluctance to read books. Therefore, it is necessary to synchronize AI coding programs with efforts to improve literacy and numeracy skills. In the education sector, AI not only develops digital skills but also requires digital ethics to ensure that technology is not misused; instead, it is used for beneficial purposes and carried out responsibly [2].

Artificial intelligence (AI) is a branch of computer science that focuses on creating intelligent systems capable of mimicking human cognitive abilities, such as learning, understanding language, problem-solving, and decision-making [3]. In education, AI has been utilized in various forms, including adaptive learning systems, educational chatbots, and data analysis for learning.

AI literacy is part of digital literacy. Digital literacy is a crucial competency in the face of the rapid development of information and communication technology. According to Gilster, digital literacy is the ability to understand and use information in various formats from various sources delivered via a computer. In the context of education, digital literacy refers to the ability of teachers and students to access, evaluate, and communicate information effectively and ethically through digital technology [4]. UNESCO emphasizes that digital literacy encompasses basic technical skills, critical thinking, and an understanding of rights and obligations in the digital world [5]. For elementary school teachers, digital literacy is an important asset in integrating technology into the learning process. Digital literacy is also closely related to information and media literacy, where teachers are not only users of technology but also critical and reflective learning facilitators [6].

The Industrial Revolution 4.0 demands that students possess relevant 21st-century skills, such as creativity, problem-solving, and collaboration. An artificial intelligence-based curriculum is able to present learning oriented towards developing these skills, by providing problem-based challenges and learning experiences relevant to the real world. The challenge is that technological infrastructure support must be adequate,

teacher training and skills in integrating AI, as well as issues of privacy and data security, as well as the ethics of AI use and awareness of potential biases are crucial to ensure the success and fairness of this technology's implementation. In realizing the educational revolution, the success of an artificial intelligence-based curriculum depends not only on technology but also requires the involvement and support of the government, educational institutions, teachers, students, parents, and the wider community [7]. The active involvement of all stakeholders will create an inclusive, innovative, and results-oriented learning environment. An AI-based curriculum holds great potential to usher in the educational revolution in a more adaptive, efficient, and competitive manner. Education can be better prepared to face future challenges and produce a well-educated young generation, ready to innovate, and able to contribute positively to the global community. With the cooperation and dedication of all parties, an AI-based curriculum will provide a strong foundation for producing a superior generation ready to face a future full of potential and opportunities [7].

Research conducted by Mahesa states that artificial intelligence has great potential to revolutionize education by presenting various new opportunities for personalized learning, including the potential and main benefits of AI in personalized learning, such as personalized learning recommendation systems, personalized assessments and feedback, adaptive learning, virtual tutors, and tutoring robots. The opportunity to apply artificial intelligence in education also presents opportunities to improve the effectiveness of learning and student learning outcomes, increase student motivation and learning engagement, assist teachers in developing more effective lesson plans, and provide broader and more equitable access to education for all students. On the other hand, challenges that need to be considered in the application of AI in education are the availability of accurate and sufficient data, limitations of technological infrastructure, unfairness of AI algorithms, and concerns about student data privacy [8].

The application of artificial intelligence in education can increase student engagement, accelerate the learning process, and provide more timely feedback. However, appropriate regulations and policies are needed to maximize the potential of artificial intelligence while minimizing the risks that may arise [9]. Artificial intelligence has great potential to transform the education system to be more adaptive and personalized, but the implementation of artificial intelligence in education must be accompanied by thorough preparation, including policy development, teacher training, and the provision of infrastructure and equitable access [9].

The implementation of artificial intelligence must be carried out carefully, considering ethical and humanitarian aspects, while maintaining the essence of education as a process of holistic human development. AI should serve as a tool to enhance, not replace, the role of teachers and human interaction in education. AI should be used in ways that strengthen teacher-student relationships and encourage the development of essential social and emotional skills. With a balanced and thoughtful approach, the use of AI in education can open the door to a new era of more effective, inclusive, and student-centered learning [10].

Holmes et al. stated that AI has great potential to revolutionize the learning process by enabling a more personalized and efficient approach to learning [11]. AI can assist teachers in analyzing student learning needs, providing automated feedback, and developing materials tailored to individual learning styles. However, implementing AI at the elementary level presents its own challenges. In addition to limited infrastructure,

elementary school teachers generally lack an adequate understanding of the concept and implementation of AI in learning.

1. AI is not intended to replace the role of teachers, but rather to strengthen the effectiveness and efficiency of learning. With a good understanding of AI, teachers can make more informed pedagogical decisions, use technology critically, and maintain ethical principles in the use of student data. According to Holmes et al. [11], indicators of artificial intelligence in education include:
2. Adaptivity: AI can adjust learning content and approaches based on students' abilities, interests, and learning styles.
3. Assessment and Feedback: AI systems can provide formative assessments and direct feedback automatically based on student performance.
4. Personalization: AI enables more individualized learning, with learning paths tailored to each student.
5. Automation of Administrative Tasks: AI helps reduce teachers' workload by automating activities such as correcting assignments, generating grade reports, and tracking attendance.
6. Intelligent Tutoring Systems: AI-based systems that provide guidance similar to human tutors, based on real-time student interactions and needs.
7. Learning Analytics: AI uses student data to analyze learning progress, detect problems, and provide learning recommendations.
8. Support for 21st Century Skills: AI facilitates the development of essential skills, including collaboration, critical thinking, problem-solving, and digital literacy.

Based on data on the growth of AI users in Indonesia in 2024, it is estimated at around 1.3 million, with a projected increase of up to 3.33 million by 2030 [12]. According to a research report released by Writer Buddy, Indonesia will be the third-largest AI user in the world from September 2022 to August 2023 [13]. Meanwhile, according to Microsoft data, 92% of office workers in Indonesia have used generative AI in the workplace, which is higher than the global average of 75% and the Asia Pacific average of 83% [14]. The Indonesia AI Report 2025, conducted by Kumparan in collaboration with Populix, shows that the adoption of generative AI chatbots in the workplace is increasingly widespread and unstoppable. 57% of 1,000 millennial and Gen Z respondents have used AI technology [15]. Meanwhile, a Jakpat survey found that 74% of respondents in Indonesia have used the ChatGPT application, making it the most popular tool, followed by Gemini and MetaAI [16]. Based on this data, AI is currently widely used in Indonesia.

AI literacy refers to the ability to comprehend the fundamental principles of AI, its potential applications, and its influence on the teaching and learning process, as well as the ethical use of technology. According to Long & Magerko,AI literacy encompasses an understanding of how AI works, how data is used and processed, and an awareness of the potential biases and ethical implications of AI systems [17]. The question that arises is the extent of teachers' literacy regarding artificial intelligence, ensuring their readiness to deliver AI lessons to elementary and middle school students.

Several previous studies have examined the importance of AI literacy for educators. For example, research by Akgun & Greenhow emphasized the importance of integrating AI into teacher training curricula to enhance their readiness for the digital era [18]. In Indonesia, a study by Sari and Pratama found that most elementary school teachers lack an adequate understanding of AI, and available training is still general

and non-contextual [19].

Implementing the Coding and Artificial Intelligence (KKA) curriculum requires not only adequate facilities and infrastructure, but also teachers, who are the spearhead of successful learning. Therefore, to successfully implement the KKA, it is crucial to understand the level of AI literacy among teachers in Indonesia. This study focused on the AI literacy level of elementary school teachers in Magelang Regency, Central Java. The Indonesian Digital Society Index (IMDI) score for Magelang Regency is considered high, at 57.16, exceeding the 2025 National IMDI of 44.53 and the Yogyakarta Special Region IMDI of 51.13 [20]. Several schools in Magelang Regency, Central Java, have also implemented Coding and AI learning materials, although not all schools have the same standards. This served as the basis for the AI literacy research for teachers conducted in Magelang Regency, Central Java.

The use of AI by teachers in Magelang Regency, Central Java, currently includes developing lesson plans, creating teaching materials for students, generating image-based quizzes, and other related activities. Currently, not all teachers in Magelang Regency have received training in preparation for the implementation of the KKA curriculum. Therefore, each teacher and school independently defines and creates their own lesson plans. Therefore, there is no definitive and uniform standard for implementing KKA learning across all schools. Some teachers use KKA books published by book publishers, while others introduce KKA to students by creating teaching materials sourced from social media. Similarly, some schools implement KKA only in grades 5 and 6, some have the subject named KKA, and others include it in other subjects, such as ICT or local content. For teachers to effectively teach KKA to students, they must also be AI literate. Therefore, given the current conditions, which are still in the early stages and not all teachers have received training on the AI curriculum, although the curriculum has been implemented, albeit not yet mandatory, it is essential to research the level of AI literacy among elementary school teachers in Magelang Regency, Central Java.

In this study, literacy levels were analyzed using Bloom's taxonomy, later revised by Anderson and Krathwohl, which identified the cognitive domains [21]. This research focuses on the indicators of mastery of AI-based learning, specifically remembering, understanding, applying, analysing, evaluating and creating. The research employed a quantitative approach [22], utilizing descriptive analysis and multiple linear regression, by distributing questionnaires to 67 elementary school teachers from 10 schools in Magelang Regency as the sample. In the next stage, a multiple linear regression (OLS) analysis was conducted to examine the effect of independent variables (grade, subject, last education, teaching experience, AI training, and school location) on the dependent variable, namely teacher literacy level. After the regression analysis was conducted, the model was tested using prerequisite tests, including normality tests, autocorrelation tests, and heteroscedasticity tests, to ensure that it meets the classical assumptions. The test was conducted using Python software (Google Colab) to verify the consistency of the results.

2 Discussion

The schools participating in this study included both public and private elementary

schools. Private schools were represented by Islamic (Muhamadiyah Elementary School) and Christian/Catholic (Kanisius Elementary School). Schools were also represented in urban, rural, and mountainous areas. The aim was to ensure a representative sample of respondents from both sociographic and geographic perspectives.

Descriptive statistical analysis (table 1) with data from 67 elementary school teacher respondents in Magelang Regency. Their average age is around 39 years with a relatively large standard deviation of 9.44 (years), indicating significant age variation. The average teaching experience of respondents is approximately 11 years. Data on variables related to competence and attitude show relatively high scores. The level of remember (Average Remember) has the highest average of 3.92, which indicates that respondents know the basic things about AI, followed by the level of attitude and values (Average Attitude and Value) (3.96) and Average Understanding (3.9), which are all on the High scale. Average Literacy is also high, with an average of 3.62.

Table 1. Descriptive Statistics for Data on Variables Competence and Attitude

	Average Remember	Average Understand	Average Apply	Average Analyzing	Average Evaluating	Average Create
count	67.00	67.00	67.00	67.00	67.00	67.00
mean	3.92	3.87	3.32	3.51	3.37	3.42
std	0.64	0.67	0.95	0.85	1.00	0.79
min	1.88	1.77	1.00	1.00	1.00	1.00
25%	3.69	3.58	2.89	3.13	3.00	3.00
50%	4.00	3.92	3.56	3.75	4.00	3.45
75%	4.38	4.23	3.89	4.00	4.00	4.00
max	5.00	5.00	5.00	5.00	5.00	5.00

The competence and attitude variables, the mean score indicates a high result (3.96). Based on the data, the AI literacy level of elementary school teachers is at 3.57. The AI literacy level measured using Bloom's Taxonomy shows that *Remember* has the highest average score (3.92), indicating that the respondents possess basic knowledge about AI. This is followed by *Understanding* (average 3.87), *Analyzing* (3.51), *Create* (3.42), *Evaluating* (3.37), and *Apply* (3.32).

Table 2. Multiple Regression Results

Multiple Regression Results:			
OLS Regression Results			
Dep. Variable:	Average	R-squared:	0.607
Model:	Literasi	Adj. R-squared:	0.448
Method:	OLS	F-statistic:	3.824
Date:	Least Squares	Prob (F-statistic):	9.32e-05

Time: No. Observations: Df Residuals: Df Model: Covariance Type:	Sat, 15 Nov 2025 07:48:39 67 47 19 nonrobust	Log-Likelihood: AIC: BIC:			-36.580 113.2 157.3	
	coef	std err	t	P>|t|	[0.025	0.975]
const	1.2637	0.617	2.048	0.046	0.022	2.505
Average Sikap Dan	0.4976	0.136	3.655	0.001	0.224	0.771
Nilai	0.0696	0.103	0.678	0.501	-0.276	0.276
Average Kendala	-0.0198	0.013	-1.549	0.128	-0.137	0.006
Usia	-0.0034	0.013	-0.258	0.797	-0.023	0.023
Lama_Mengajar	-0.0275	0.212	-0.130	0.897	-0.046	0.399
Jenis Kelamin_Perempuan	0.0929	0.207	0.450	0.655	-0.509	0.509
Lokasi Sekolah_Kota	0.3037	0.359	0.846	0.402	-0.030	1.026
Kelas_Kelas 1	0.3260	0.342	0.952	0.346	-0.454	1.015
Kelas_Kelas 2	0.0182	0.375	0.049	0.962	-0.773	0.819
Kelas_Kelas 3	0.1100	0.353	0.312	0.757	-0.323	0.717
Kelas_Kelas 4	0.0265	0.343	0.077	0.939	-0.717	0.550
Kelas_Kelas 5	-0.1378	0.342	-0.403	0.689	-0.418	0.498
Kelas_Kelas 6	0.1828	0.654	0.280	0.781	-1.498	1.311
Kelas_PAI	0.4988	0.404	1.236	0.223	-0.363	1.259
Kelas_PJOK	0.1655	0.544	0.304	0.762	-1.164	1.001
Kelas_TIK	-0.0838	0.620	-0.135	0.893	-1.737	1.119
Kelas_shadow teacher	0.3494	0.324	1.079	0.286	-0.599	1.277
Mapel AI_Ya	0.3791	0.368	1.031	0.308	-0.888	
Pendidikan_Magister (S2)	0.7191	0.277	2.593	0.013	-0.664	
Pendidikan_Sarjana (S1)	0.5696	0.158	3.598	0.001	-0.826	
Pelatihan AI_Ya					-1.132	
					-0.313	
					-0.928	
					-1.331	
					-0.302	
					-0.361	
					0.161	
					0.251	

Omnibus:	1.324	Durbin-Watson:	1.898
Prob(Omnibus):	0.516	Jarque-Bera (JB):	0.703
Skew:	-0.185	Prob(JB):	0.704
Kurtosis:	3.340	Cond. No.	6.27e+17

Next, a multiple linear regression analysis (table 2) was conducted to examine the effect of several independent variables on the average AI literacy of elementary school teachers (Average Literacy). The regression model used was Ordinary Least Squares (OLS). Based on the regression output, the following information was obtained:

1. The multiple linear regression analysis revealed that the model was significant (F-statistic = 3.824; p-value = 9.32e-05 < 0.001), with an R^2 of 0.607, indicating that the variables in the model can explain 60.7% of the variation in AI literacy among elementary school teachers.
2. The variables that had a positive and significant effect on the average AI literacy of elementary school teachers were teacher attitudes and values (Coefficient = 0.5), undergraduate education (Coefficient = 0.72), and AI training (Coefficient = 0.57).

After conducting the multiple linear regression analysis, a series of classical assumption tests was performed to ensure that the constructed regression model meets the required statistical criteria. These assumption tests are essential to confirm that the estimated parameters are unbiased, efficient, and appropriately interpretable. The results of the assumption tests indicate:

a. Residual normality: Based on the Omnibus test (p = 0.516) and the Jarque–Bera test (p = 0.704), the model residuals are normally distributed. This finding is further supported by the Q–Q plot of residuals (Picture 1) and the histogram plot of residuals (Picture 2), both of which indicate a normal distribution of the residuals.

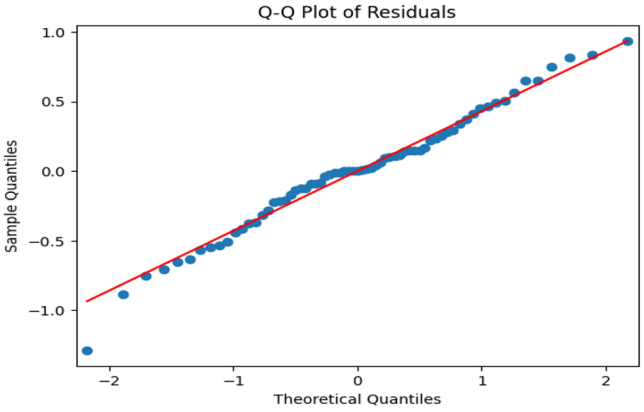

Fig.1.Q-Q Plot of Residuals

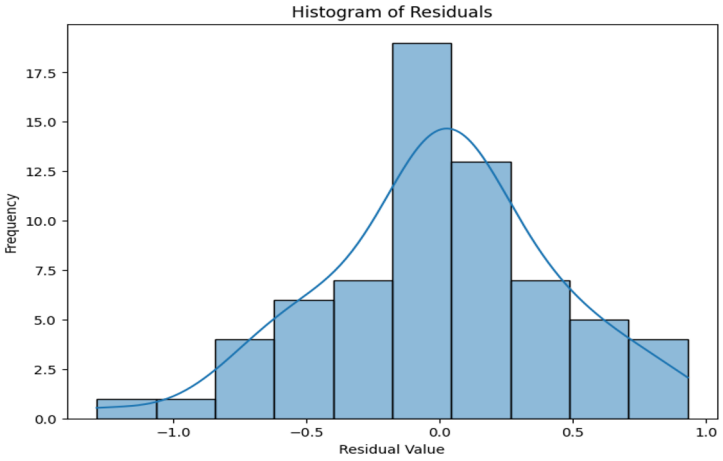

Fig.2. Histogram Plot of Residuals

b. Autocorrelation: In this model, the Durbin–Watson value is 1.898, which is close to 2. This indicates that the model residuals do not exhibit serious autocorrelation, meaning that the assumption of residual independence is satisfied. Consequently, the regression results and the significance tests (t and F) can be interpreted validly.

c. Heteroscedasticity: Since the p-value (0.091) is greater than the 0.05 significance threshold, we conclude that there is no significant evidence of heteroskedasticity in the regression model. This is a favorable result, as homoskedasticity (constant error variance) is one of the key assumptions of OLS regression.

Thus, the regression model meets the classical OLS assumptions, and the coefficient estimates and significance test results are reliable.

3 Conclusion

Based on the discussion, the AI literacy level of elementary school teachers in Magelang Regency, Central Java, is classified as relatively high. Several factors influence this, including teachers' attitudes and values toward AI, their experiences with undergraduate education, and their familiarity with AI training. Implementing Coding and Artificial Intelligence (KKA) lessons at the elementary school level starting in the 2025/2026 academic year requires teacher and school readiness. Implementing the KKA curriculum depends not only on teachers' technical skills but also on their reflective attitudes, ethical values, and conceptual understanding of AI. Continuous training based on Bloom's Taxonomy is recommended to strengthen teacher competency in AI-based adaptive learning.

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