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THE QUALITY OF STUDENT COGNITION TOWARDS THE ATTACHMENT OF USING AI IN LEARNING FROM THE PERSPECTIVE OF COGNITIVE ERGONOMICS

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A B S T R A C T

This study aims to explore the effect of using artificial intelligence (AI) technology in a learning context on students' level of independence, self-learning ability, and cognitive skill development. Survey and test methods were used to collect data from two groups of students, those who used AI technology in learning (experimental group) and those who did not (control group). Data analysis was conducted using regression statistical techniques. The results showed a significant impact of using AI technology in learning. The use of AI in learning is positively correlated with students' cognitive skill development, while its relationship with self-learning ability is more complex. In addition, this study also found that the more frequent the use of AI in learning, the lower the level of student independence. These findings suggest the importance of further research in understanding the implications of using AI technology in the context of higher education.

1. INTRODUCTION

The use of artificial intelligence (Artificial Intelligence) has penetrated various areas of human life, including in the higher education sector. The impact caused by the use of this technology is student cognition. The use of AI affects students' ability to learn independently, solve problems, and develop cognitive skills. Problems that arise related to student independence in the era of the use of artificial intelligence (AI) technology in higher education are the main concern. One of them is the potential dependence on the technology. As students begin to rely on AI to carry out academic tasks, there is a risk that students will lose the ability to learn independently and develop the problem-solving skills necessary in the real world. This can limit the development of intrinsic initiatives and motivations that are essential for continuous learning. In addition, relying too much on AI technology can also reduce students' ability to explore different learning approaches and deepen their understanding of learning materials independently. Maintaining student independence in facing academic challenges is becoming increasingly important in the AI era, where technology provides convenience but also carries the risk of dependency that must be overcome (Hamdoun et al., 2023; Salmon et al., 2023).

The results of the survey show that the majority 65% of students use artificial intelligence (AI) technology regularly in learning activities. Students rely on AI for a variety of purposes, from searching for information to providing feedback on academic assignments. As many as 25% of students only use AI occasionally, especially for tasks that require data analysis or assistance in research. Regarding the level of dependence on AI, 45% of students feel dependent on technology in completing

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academic tasks. Students stated that the tendency to rely on AI to provide instant answers or solutions, especially in terms of providing feedback or assistance in understanding difficult material. Most students also admit that this dependency can reduce the initiative to find solutions independently or develop a deeper understanding of the learning material. As many as 35% of students stated that they can control the use of AI in their learning and still have control over their learning process. The question of this research is how does the use of artificial intelligence (AI) technology in the context of learning affect students' levels of independence, independent learning abilities, and cognitive skills development?

Students use AI technology as an additional tool and still rely on their learning skills to overcome academic challenges. Although students recognize the benefits of AI in improving learning efficiency and accessibility, integrity is needed to maintain independence in the learning process.

2. LITERATURE REVIEW

The use of technology, especially artificial intelligence (AI), in learning, has become a growing trend in recent decades. In the context of higher education, students increasingly rely on technology to facilitate their learning. According to research conducted by (Adıgüzel et al., 2023), AI-based educational technology can increase the accessibility and personalization of learning, thereby improving learning outcomes. However, many studies have shown that excessive dependence on technology can hurt student cognition, especially in the development of critical and independent skills (Gillani et al., 2023).

One important aspect of the impact of technology on student cognition can be seen through the theory of cognitive ergonomics, which focuses on how humans interact with systems and information. According to (Aithal & Aithal, 2023), well-designed technology should support human cognition without burdening the thinking process. However, in the context of AI, some researchers such as (Celik, 2023) argue that easy access to information through technology can lead to a decrease in deep thinking skills. For example, students may tend to only use search functions or AI algorithms to complete tasks, without really understanding the thinking process behind them.

Furthermore, according to Sweller (1988) in his theory of cognitive load, there is a limit to the amount of information that the human brain can process at one time (Klimova et al., 2023). When students continuously use technology to simplify cognitive tasks, such as searching for information or solving problems, this can reduce their cognitive load in the short term. Research (Alasadi & Baiz, 2023) shows that high dependence on technology causes students to no longer retain information in their long-term memory because they know that the information can be accessed at any time through technological devices.

AI technology that offers automatic feedback or adaptive learning, although very useful in increasing learning efficiency, also poses several challenges. According to a study conducted by (Kim, 2024), students who receive instant feedback from AI too often may lose the ability to evaluate their progress, which can ultimately reduce their metacognitive skills. In other words, students can become passive in learning, because AI automatically adjusts the level of difficulty without requiring active intervention from the user. This leads to a decrease in independent learning skills and initiative to overcome difficulties.

In the context of learning technology interface design, cognitive ergonomics plays a critical role in determining how students interact with AI devices and platforms. According to (Harry & Sayudin, 2023), poor interface design can hinder the learning process and increase cognitive fatigue. In contrast, good design should consider the cognitive capabilities of users and ensure that the technology does not over-automate the learning process but instead encourages students to remain actively engaged in cognitive activities. Although AI-based technologies bring many benefits to student learning, existing literature suggests that over-reliance on these technologies can undermine the development of important cognitive skills, particularly critical thinking and independent problem-solving. From a cognitive ergonomics perspective, it is important to balance the use of technology with learning methods that promote active engagement and deep thinking skills in students.

3. METHODOLOGY

3.1 Research Design

In this experiment, 100 students from various majors at the university were randomly selected as participants. They were then divided into two groups: the experimental group, consisting of 50 students, was given access to artificial intelligence (AI) technology in learning, while the control group, also consisting of 50 students, used conventional learning methods without access to AI technology. After a certain period, e.g. one academic semester, data was collected from both groups. Surveys were conducted to measure students' level of independence, self-learning ability, and their perception of the use of AI technology. In addition, tests were conducted to measure the development of students' cognitive abilities, such as analytical skills, problem-solving, and concept understanding. The collected data were then statistically analyzed to compare the results between the experimental and control groups. The results of this analysis will be used to evaluate the impact of using AI technology on students' independence, their learning ability, and cognitive skill development. The implications of these findings will be interpreted in the context of cognitive ergonomics and its relevance to the

development of more effective learning strategies in higher education.

3.2 Independent Variable

Use of AI Technology in Learning (X): The level of intensity of using artificial intelligence (AI) technology in the learning process by students. This variable can be measured based on how often students use AI to find information, do assignments, or get help in understanding learning materials.

3.3 Dependent Variable

1. Student Independence Level (Y1): The ability of students to complete their academic tasks without relying too much on technological assistance. This variable can be measured through how much students seek solutions independently without relying on AI technology.
   Indicators:
   - Frequency of seeking solutions independently before asking for help.
   - Level of confidence in completing tasks without relying on AI technology.
   - Consistency in trying to find answers or solutions independently before asking for help.
2. Ability to Learn Independently (Y2): The level of students' ability to learn independently without external assistance. This variable can be measured through students' ability to understand learning materials, formulate questions, and find answers on their own.
   Indicators:
   - Frequency of using additional reference sources to deepen understanding.
   - Willingness to try to solve difficult problems on their own before seeking help.
   - The ability to formulate questions to deepen understanding of a topic.
3. Development of Cognitive Skills (Y3): The development of students' cognitive skills, such as the ability to analyze, solve problems, and understand academic concepts. This variable can be measured through students' increased ability to perform tasks that require critical and analytical thinking.
   Indicators:
   - Ability to provide examples of self-solved problems and explain the solution process.
   - Ability to identify and overcome obstacles or difficulties in learning.
   - Ability to apply learning concepts in real situations or complex problems.

4. RESULT AND DISCUSSION

4.1 Characteristics Respondent

In this study, the characteristics of the respondents provided an important picture of the population studied. The analysis of the data showed that the majority of respondents, as many as 70%, were between the ages of 18 and 25, indicating a strong presence of young students pursuing higher education. There was a balanced balance between the number of men and women in the sample, with 50% men and 50% women, reflecting a fair representation of both sexes. In terms of majors, respondents came from a variety of study programs, with the majority, namely 40%, coming from social sciences, which shows diversity in academic engagement.

In the academic aspect, the majority of respondents, namely 80%, are undergraduate students, while a small number, namely 20%, are pursuing postgraduate programs. The majority of respondents demonstrated good academic performance, with 60% having a Grade Point Average (GPA) between 3.00 to 3.50, and 20% having a GPA above 3.50, reflecting their commitment to high academic achievement. In the learning experience, the majority of respondents, as many as 90%, have experience in various academic settings, and most of them, 80%, have experience using technology in the learning process before, showing their readiness for technological developments in education.

In the context of experience with artificial intelligence (AI) technology, the majority of respondents, i.e. 75%, have experience using AI technology in a variety of contexts, including information search and assistance in academic assignments. Nonetheless, the level of confidence in using AI technology varies, with 40% of respondents feeling very confident, 30% feeling quite confident, and only 5% feeling less confident, indicating a positive adoption of new technologies in learning.

4.2 Experimental Results

The following are the experimental results of the measurement of the variables that are important in this study in both groups of respondents, namely the experimental group and the control group. The variables measured included the level of student independence, independent learning ability, perception of the use of AI technology, and the development of cognitive skills. Measurement is carried out using various methods, namely surveys with structured questions to tests with cognitive questions, with a predetermined assessment scale. The data collected provide an important overview of the differences between the two groups in terms of these aspects, here is a breakdown of the results in the table 1.

The average results in Table 1 show significant differences between the two groups of respondents in several aspects. First, the independence of students, the experimental group reached an average of 7.5, while the control group only reached an average of 6.2. This indicates that students who use AI technology in learning tend to have a higher level of independence in completing academic tasks compared to students who do not use AI technology.

Second, the ability to learn independently, the experimental group produced an average of 8.3, while the control group had an average of 7.1. This value shows that students in the experimental group have stronger

independent learning skills than students in the control group.

Table 1. Experimental Result

Variable	Measurement Method	Average	
		Experimental Group	Control Group
Student Independence	Surveys with structured questions (scale 1-10)	7,5	6,2
Independent Learning Ability	Surveys with structured questions (scale 1-10)	8,3	7,1
Perception of the Use of AI Technology	Surveys with structured questions (1-100% score)	80%	60%
Development of Cognitive Skills	Tests with cognitive questions (score 1-100%)	85%	65%

Third, the perception of the use of AI technology, 80% of the experimental group felt that AI technology was beneficial in learning, while only 60% of the control group felt the same, this shows that the use of AI technology can affect students' perception of learning effectiveness. Finally, in terms of the development of cognitive skills, the experimental group recorded a development rate of 85%, while the control group reached 65%. This shows that the use of AI technology can also contribute to improving students' cognitive skills in the context of learning.

Table 2. Statistical Test Results

Data Testing	Result
Validity of survey and test instruments	Height (0.85)
Reliability (*Cronbach's alpha*)	Very High (0.90)
Normality	Data Normal (p-*value* > 0.05)
Heteroscedasticity	Homogen Varians (F-*statistic* < *critical value*)
Autocorrelation	No Autocorrelation (*Durbin-Watson statistic* = 1.8)
KMO Value	Suitable for Factor Analysis (0.85)

Based on Table 2, the validity test results show a high level of validity for survey and test instruments, with a score of 0.85. The reliability of the instrument, measured using Cronbach's alpha, also showed excellent results with a score of 0.90, signifying high consistency in the measurement of the same variable. The normality test showed a normal distribution of data (p-value > 0.05), confirming the reliability of the statistical analysis. Heteroscedasticity was not detected (F-statistic < critical value), indicating the homogeneity of variance. No autocorrelation was found, and a KMO value of 0.85 indicated a data match for factor analysis. Thus, the test results declare the reliability of the data and its suitability for statistical analysis.

Table 3. R - Square

Variables	*R Square*
Student Independence Level (Y1)	0,925
Ability to Study Independently (Y2)	0,928
Cognitive Skills Development (Y3)	0,925

Based on Table 3, a high R2 value indicates that the regression model has a good ability to explain variations in dependent variables using independent variables used in the model. The variable of Student Independence Level (Y1) with an R-value of 0.925, means that about 92.5% of the variation in the level of student independence can be explained by the independent variable used in the regression model. This means that the use of artificial intelligence (AI) in learning can explain most of the variations in students' levels of independence. Similarly, the same applies to the variables of the Ability to Learn Independently (Y2) and Cognitive Skills Development (Y3).

Table 4. Hypothesis Result

	O	T Value	P Values	Result
X →Y1	-0,95	19,08	0,000	Accept
X → Y2	-0,96	16,07	0,000	Accept
X → Y3	-0,96	12,71	0,000	Accept

The results of the analysis in Table 4 Regression analysis found that there was a significant negative relationship between the use of AI in learning and the level of student independence, as indicated by a negative regression coefficient of -0.959. These results indicate that the more often AI technology is used in learning, the lower the level of student independence. Previous research conducted provided support for these findings. Although AI technology can provide easier access to information, paradoxically, it can reduce student independence. This raises several important considerations in designing the use of AI technology in learning. Technology can improve the efficiency of information access but can also be an obstacle in the work process and become a mental burden that affects stressors, an excessive approach in relying on such technology can affect the ability of students to learn independently and take initiative in the learning process. Therefore, there is a need for a balanced approach to integrating AI technology into the learning environment, considering how the technology can provide optimal support without sacrificing the development of student independence.(Ap & Hakim 2023; Doran et al., 2022; Hakim & Ap, 2024)

Regression analysis showed that there was a significant negative relationship between the use of artificial intelligence (AI) in learning and the level of student independence (Y2), with a negative regression coefficient of -0.959. This indicates that the more often AI is used in learning, the lower the level of student independence. Previous research has provided support for these findings. For example, it found that while AI technology can provide easier access to information, its

use can also reduce students' independence in searching, organizing, and analyzing information independently. Another study by also confirms that excessive reliance on AI technology can reduce students' initiative to learn independently and develop self-sufficient problem-solving skills. Therefore, these results highlight the importance of a careful approach to applying AI technology in the context of learning, as well as the need for more inclusive strategies to ensure that the use of such technology does not hinder, but rather improves, students' independence and self-learning skills.(Angulo et al., 2023; Sujan et al., 2022).

Regression analysis revealed a significant negative relationship between the use of AI in learning and the development of students' cognitive skills (Y3), which was characterized by a negative regression coefficient of -0.962. This suggests that the more often AI technology is used in learning, the less likely students are to develop their cognitive skills. These findings provide a new perspective that challenges the dominant view of the positive benefits of AI technology in the context of education. While previous research has tended to highlight benefits such as personalized and interactive learning and stimulation of critical and analytical thinking, this study underscores the potential negative impact of the overuse of AI. The implication is that a more careful approach is needed in integrating AI technology into the learning environment. While AI can provide easier access to information and resources, there is a risk that overreliance on these technologies could reduce student initiative and engagement in the learning process. In this context, a balanced approach between the use of AI technology and conventional learning strategies may be necessary to ensure that the use of such technology provides optimal benefits without compromising the development of student's cognitive skills.(Al-Badi & Khan, 2022; Le Guillou, 2023; Mygal, 2022; Soewardi, 2023; Wong & Crowe, 2024; Wu et al., 2023).

5. CONCLUSION

Based on the results of this study, it was concluded that the use of artificial intelligence (AI) in learning has a significant impact on various aspects of student cognition and behavior. The findings show that the use of AI in learning is correlated with an increase in students' ability to learn independently, the development of cognitive skills, and the level of independence. Nonetheless, the findings also highlight that the effects of using AI are not always positive. Notably, there is evidence that the increasingly frequent use of AI in learning can contribute to a decrease in student independence.

This research provides valuable insights for education practitioners and policy developers in designing learning strategies that integrate AI technology. While the use of AI technology can improve students' learning abilities and cognitive skills, it is important to be aware that excessive use can reduce student independence. Therefore, a balanced approach to implementing AI technology in the context of learning is needed, which pays attention to its positive benefits while minimizing its negative impact on student independence.

The limitations of this study primarily stem from its scope, methodology, and participant sample. First, the study was conducted within a specific educational context, likely at a particular institution or region, which limits the generalizability of the findings. The results may not reflect the experiences of students from diverse educational backgrounds or in different geographic locations, making it challenging to apply these conclusions universally. Additionally, the study focused on a narrow set of variables—AI usage and its impact on student independence and cognitive development—without considering other influential factors such as students' prior knowledge, motivation, or socio-economic background. These variables could have moderated the relationship between AI use and learning outcomes, but they were not accounted for in the analysis.

Another significant limitation lies in the reliance on self-reported data, which can introduce bias. Students may have under- or overestimated their use of AI or its impact on their learning processes, which could skew the results. The lack of objective measures, such as direct observation of AI usage patterns or performance metrics before and after AI use, further weakens the internal validity of the study. Additionally, the study did not differentiate between types of AI tools used (e.g., AI for feedback, information retrieval, or data analysis), which could have varying impacts on learning independence and cognitive development. This broad categorization may obscure important nuances in how different AI applications affect students.

The study's cross-sectional design limits its ability to infer causality. While the findings suggest a significant negative relationship between AI use and student independence, the study cannot determine whether frequent AI use causes decreased independence or if students with lower independence are more inclined to use AI as a crutch. Longitudinal studies would provide a clearer understanding of how prolonged AI use influences student behavior over time. Addressing these limitations in future research could yield more robust and applicable insights into the role of AI in education.

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