

# Analysis of Artificial Intelligence Literacy in the Blended Learning Model in Higher Education

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## Abstract

The purpose of the study was to determine the literacy of artificial intelligence in the blended learning model by looking at the influence of: (1) introduction to artificial intelligence (IAI) on data security and privacy (DSP), (2) Advantages and Disadvantages of Artificial Intelligence (ADAI) on DSP, (3) Implications of Artificial Intelligence (IAII) on DSP, (4) IAI on DSP moderated by Ethics and Laws of Artificial Intelligence (ELAI), (5) ADAI on DSP moderated by ELAI, (6) IAII on DSP moderated by ELAI, and (7) ELAI on DSP. The study design is *ex post de facto*. The study sample is 4th semester 2021 students who have studied web programming courses in the department of informatics and computer engineering with a total of 156 students. Data analysis with partial least square (PLS) using the SmartPLS application. The results showed that: (1) IAI has a positive but insignificant effect on DSP, (2) ADAI has a positive and significant effect on DSP, (3) IAII has a positive and significant effect on DSP, (4) IAI has no positive and insignificant effect on DSP moderated by ELAI, (5) ADAI has a positive and significant effect on DSP moderated by ELAI, (6) IAII has no positive and insignificant effect on DSP moderated by ELAI, and (7) ELAI has a positive and significant effect on DSP. In addition, the analysis results show an acceptable level of variance of the lecturer trust model (68.8%). This means that there is 31.2% variance in the dependent variable explained by other factors.

*Keywords:* literacy; artificial intelligence; blended learning

## 1. Introduction

Artificial Intelligence (AI) has become a topic of interest in various fields, including education. In higher education, the integration of AI into the learning process has the potential to increase student engagement, improve learning outcomes, and provide personalized learning experiences (Lainjo & Tsmouche, 2023). One approach to incorporating AI into higher education is through blended learning models, which combine traditional face-to-face instruction with online learning activities (Chan, 2019). This synthesis will explore the analysis of AI literacy in blended learning models in higher education, drawing on relevant references to provide a comprehensive understanding of the topic.

AI literacy refers to the knowledge and skills required to understand, use, and critically evaluate AI technologies and their applications (Ng et al., 2021). In the context of higher education, AI literacy includes the ability to use AI tools effectively and an understanding of the ethical considerations associated with AI (Shapiro et al., 2018). Developing AI literacy among college students is critical as it equips them with the necessary skills to navigate an increasingly AI-driven world and make informed decisions (Zhao et al., 2022).

The blended learning model combines face-to-face instruction with online learning activities, creating a flexible and interactive learning environment. This model enables a personalized learning experience, as students can engage with the subject matter at their own pace and receive immediate feedback. Blended learning also encourages active learning and collaboration among students, improving critical thinking and problem-solving skills (Chan, 2019; Della Fadhilatunisa et al., 2020). Selain itu, model *blended learning* juga mampu meningkatkan motivasi belajar dan hasil belajar peserta didik serta mampu membantu peningkatan partisipasi belajar mahasiswa di kelas baik di tatap muka dan online di media e-learning (Fadhilatunisa et al., 2020; Fakhri et al., 2022) The integration of AI into the blended learning model has the potential to further enhance these benefits.

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The integration of AI into the blended learning model offers several opportunities to enhance the learning experience in higher education. AI technologies can be used to personalize learning by adapting instructional materials and assessments to the needs and preferences of individual students (Popenici & Kerr, 2017). For example, an adaptive learning system powered by AI can analyze student performance data and provide personalized recommendations for further study (Popenici & Kerr, 2017). This individualized approach can help students to better understand and retain course content.

In addition, AI can support instructors in designing and delivering effective instruction. Natural Language Processing (NLP) techniques can be used to analyze students' written responses and provide automated feedback (Conijn et al., 2020). This feedback can help students improve their writing skills and deepen their understanding of the subject matter. AI can also assist instructors in identifying students who may be struggling and provide targeted interventions to support their learning (Calatayud et al., 2021).

Several studies have explored AI literacy analysis in blended learning models in higher education. These studies have investigated various aspects of AI literacy, including definitions, teaching methods, evaluation, and ethical considerations. One study conducted a systematic review of research on AI applications in higher education and highlighted the need for educators to understand how to utilize AI pedagogically on a broader scale. This study emphasized the importance of integrating AI literacy into the curriculum and providing professional development opportunities for educators to improve their AI literacy skills (Zawacki-Richter et al., 2019).

Another study focused on the development of AI literacy among primary and secondary school teachers in China. This study used structural equation modeling to examine the correlations between various dimensions of AI literacy and found that teachers' AI literacy positively influenced their teaching practices (Zhao et al., 2022). The findings of this study highlight the importance of providing training and support for educators to develop their AI literacy skills.

Further, a review paper explored the impact of AI on teaching and learning in higher education. The paper discussed the emergence of AI in education and its potential to transform traditional teaching methods. The paper emphasized the need for educators to adapt their instructional practices to effectively integrate AI into the learning process (Fahimirad & Kotamjani, 2018).

Ethical considerations related to AI literacy in blended learning models have also been investigated. A study investigated ethical issues related to AI in education and emphasized the importance of teaching students about the ethical implications of AI technologies. The study suggested incorporating ethical discussions and case studies into the curriculum to promote ethical AI literacy among students (Ng et al., 2021).

The analysis of AI literacy in blended learning models in higher education is a complex and multifaceted topic. It requires a comprehensive understanding of AI technologies, their applications, and the ethical considerations associated with their use. The integration of AI into blended learning models offers opportunities to enhance the learning experience in higher education by personalizing instruction, providing immediate feedback, and supporting instructors in designing effective instruction. However, it is important to ensure that educators and students have the necessary AI literacy skills to navigate AI-driven learning environments. Professional development opportunities for educators and the inclusion of AI literacy in the curriculum are important steps in promoting AI literacy in higher education.

## **2. Research Method and Materials**

The type of study used is non-experimental quantitative study, namely ex-post facto. Ex-post facto study is research in which the independent variables of the study have occurred, the researcher starts with the observation of the dependent variable then looks for the cause in a study (Kerlinger, 1986).

The population of this study were students of the Department of Informatics and Computer Engineering, Faculty of Engineering, Makassar State University who had taken web programming courses. The study sample amounted to 156 which was determined by Issac & Michael (1981) criteria and sampling distribution with proportional random sampling technique (Isaac & Michael, 1981). Samples with certain considerations or based on the objectives of the study. Sample determination also considers the structural equation modeling (SEM) analysis approach. For SEM analysis using a sample of 100-200 (Ghozali & Fuad, 2012) or 5-10 times the number of observation parameters (Hair et al., 2006). For small samples with complex models, it is recommended to use SmartPLS software (Santosa, 2018).

The sample determination was carried out using purposive sampling technique, which is a sampling technique with certain considerations. The sample used in this study were students who had studied web programming courses. Data

collection techniques through questionnaires. This questionnaire is used in obtaining quantitative data which aims to reveal respondents' responses regarding AI literacy in the blended learning model in higher education. The table 1 show the indicators for the questionnaire sheet in this study.

Table 1. The indicators for the questionnaire sheet

No.	Variable	Statement
1	Introduction to Artificial Intelligence (IAI)	1 – 7
2	Advantages and Disadvantages of Artificial Intelligence (ADAI)	8 - 13
3	Implications of Artificial Intelligence (IAII)	14 – 18
4	Ethics and Laws of Artificial Intelligence (ELAI)	19 - 21
5	Data Security and Privacy (DSP)	22 - 26

Instrument validity in this study uses construct validity. Construct validity uses confirmatory factor analysis (CFA) with the help of SmartPLS software. Meanwhile, the calculation of reliability uses the rules of construct reliability (CR) and variance extracted (VE). A construct or variable is said to be reliable if it provides a CR value  $\geq 0.7$  and VE  $\geq 0.5$  (Hair et al., 2017).

Quantitative data analysis techniques in study using descriptive statistical analysis using IBM SPSS and structural equation modeling (SEM) analysis with the help of SmartPLS software. SEM analysis is used to determine the effect of exogenous latent variables on endogenous latent variables.

The SEM analysis requirements test uses normality tests (univariate normality and multivariate normality) and multicollinearity. Data is declared to meet the assumption of normality if the pvalue of skewness and kurtosis  $> 0.05$ . Independent variables are said not to occur multicollinearity if the tolerance value  $> 0.1$  and VIF  $< 10$ . SEM will produce and analyze measurement models (CFA) and structural models. The analysis was carried out using SmartPLS software.

The hypotheses in this study are:

- H1: There is a significant positive effect of the introduction of artificial intelligence on data security and privacy.
- H2: There is a significant positive effect of Advantages and Disadvantages of Artificial Intelligence on data security and privacy
- H3: There is a significant positive effect of Artificial Intelligence Implications on data security and privacy
- H4: There is a significant positive effect of Introduction of Artificial Intelligence on data security and privacy moderated by Ethics and Law of Artificial Intelligence
- H5: There is a significant positive effect of Advantages and Disadvantages of Artificial Intelligence on data security and privacy moderated by Ethics and Law of Artificial Intelligence
- H6: There is a significant positive effect of Implications of Artificial Intelligence on data security and privacy moderated by Ethics and Laws of Artificial Intelligence
- H7: There is a significant positive effect of Ethics and Laws of Artificial Intelligence on data security and privacy

### 3. Results and Discussion

#### 3.1. Descriptive Statistics

The participants in this study were (undergraduate) students who attended blended learning courses during the Covid-19 endemic period at the Department of Informatics and Computer Engineering, Universitas Negeri Makassar, Indonesia. The survey link was saved on the researcher's google form and then proportional sampling method was used to further distribute the survey. A total of 155 participants responded to understand artificial intelligence literacy. As the data was collected via Google form and all questions were answered and required, there was no missing data. Respondents consisted of 46% females and 54% males. Of these, students from Informatics and Computer Engineering majors were included.

Descriptive analysis was conducted on the survey items, as shown in Table 2. The standard deviations ranged from -2 to +2 indicating that there was not much deviation from the normal distribution and hence most of the statistical analysis could be applied to the models in this study (Badri et al., 2016).

Table 2. Descriptive Analysis

Item	Mean	Standard of Deviation
ADAI1	3,353	0,766
ADAI2	3,481	0,764
ADAI3	3,404	0,791
ADAI4	3,506	0,797
ADAI5	3,346	0,829
ADAI6	3,109	0,844
DSP1	2,994	0,851
DSP2	2,808	0,802
DSP3	3,327	0,778
DSP4	3,410	0,775
DSP5	3,045	0,787
ELAI1	2,994	0,772
ELAI2	2,724	0,805
IAI1	3,769	0,807
IAI2	3,609	0,703
IAI3	3,538	0,763
IAI4	3,006	0,789
IAI5	2,840	0,738
IAI6	3,205	0,798
IAI7	2,756	0,835
IAII1	2,859	0,812
IAII2	3,026	0,839
IAII3	3,282	0,791
IAII4	3,090	0,835
IAII5	2,897	0,841

However, statements DSP1, DSP2, ELAI-1,-2, IAI5, IAI7, IAII-1 and IAII-5 show mean values below 3 so that these 8 (eight) indicators are classified in the neutral category and need further improvement and investigation.

### 3.2. Reflective Measurement Model Analysis

The results of the reflective measurement model analysis in Table 3, show that the outer loading value for each construct item/indicator from the student assessment results is above the minimum value of 0.60. Because all results are greater than 0.70, the indicators are proven to be reliable (Hair, 2017). However, there are 4 items that have an outer loading of less than 0.7 (GBL1, GBL7, LO8, and SM4). This item is not removed, because this indicator does not cause a decrease in composite reliability and AVE [19]. However, there are several indicators that have an outer loading value below 0.4, namely in the GBL latent variable, namely GBL 2 to 6, the SM latent variable, namely SM1 to SM3 and the LO latent variable, namely LO5 and LO6 so that all indicators in this latent variable are eliminated.

The internal consistency value obtained is above 0.7. This means that the internal consistency value is satisfactory because it is at a value of 0.7-0.9 (Nunnally & Bernstein, 1994). This criterion is also used for Cronbach Alpha, Rho A and composite reliability. Based on the composite reliability and Rho A values of the constructs, all constructs are reliable. Convergent validity is indicated by AVE. The analysis results in Table 3 show that all AVEs are higher than 0.50. The AVE value must be greater than 0.50 to explain more than half of the indicator variance (Hair et al., 2017).

Furthermore, the discriminant validity of the constructs is presented in tables 4 and 5. Discriminant validity uses the Fornell and Larcker (1981) criteria (Fornell & Larcker, 1981) and Cross loading by comparing all item loadings. The Fornell Larckel criterion is based on AVE, the most popular validity measurement used in PLS-SEM. For reflective models, the AVE must be greater than the squared correlation to investigate the discriminant validity of the model (Mehmetoglu, 2021). Table 4 shows the Fornell Larckel Criteria. All constructs in the model have good discriminant validity.

**Table 3.** Reflective Measurement Model Analysis Results

Construct	Item	Outlier Loadings	Cronbach's Alpha	rho_A	Composite Reliability	AVE
Introduction to Artificial Intelligence	IAI 1	0,626	0,824	0,840	0,876	0,589
	IAI 2	0,780				
	IAI 3	0,843				
	IAI 4	0,781				
	IAI 5	0,790				
Advantages and Disadvantages of Artificial Intelligence	ADAI 1	0,759	0,883	0,886	0,912	0,634
	ADAI 2	0,791				
	ADAI 3	0,856				
	ADAI 4	0,868				
	ADAI 5	0,810				
	ADAI 6	0,678				
Implications of Artificial Intelligence	IAII 1	0,812	0,895	0,896	0,923	0,704
	IAII 2	0,853				
	IAII 3	0,832				
	IAII 4	0,875				
	IAII 5	0,823				
Data Security and Privacy	DSP 1	0,817	0,837	0,840	0,885	0,606
	DSP 2	0,766				
	DSP 3	0,734				
	DSP 4	0,755				
	DSP 5	0,817				
Ethics and Laws of Artificial Intelligence	ELAI 1	0,938	0,829	0,850	0,921	0,853
	ELAI 2	0,909				

**Table 4.** Fornell Larckell Table (Correlation Between Factors and Root AVE)

	ADAI	DSP	ELAI	IAI	IAII
ADAI	0,796				
DSP	0,644	0,778			
ELAI	0,559	0,739	0,924		
IAI	0,570	0,522	0,531	0,767	
IAII	0,645	0,757	0,786	0,589	0,839

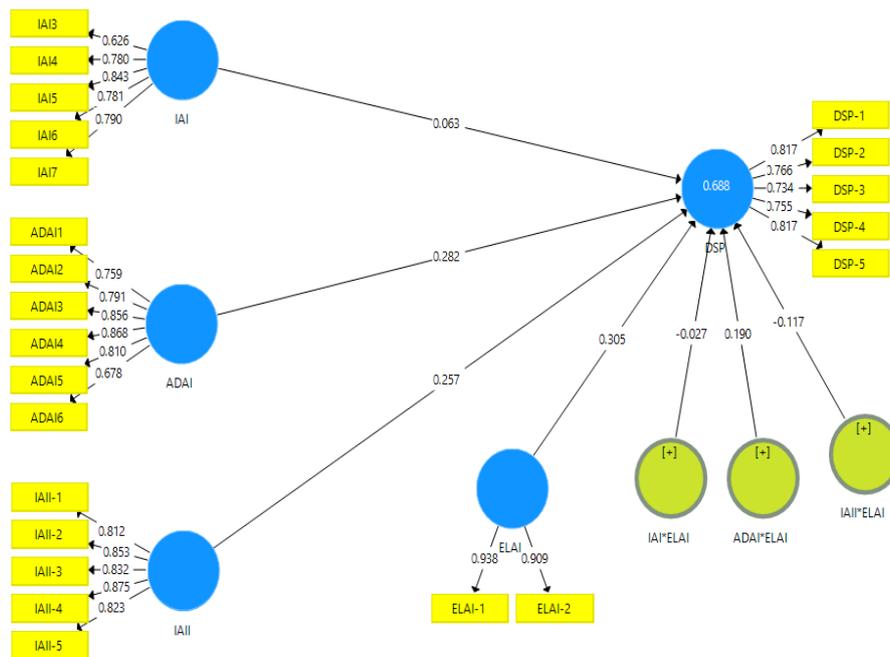
Table 5 shows the cross-loadings of all indicators. All indicators show the highest loadings on each construct among all other constructs (Barclay et al., 1995; Hair, 2017). As a result, all items/indicators in a given construct meet the criteria of good discriminant validity.

### 3.3. Structural Model Analysis (Hypothesis Test)

The PLS estimation results of structural equation modeling, path coefficient values, and item loadings for the study constructs are presented in Figure 1.

**Table 5.** Cross-Loading Variabel Laten

	ADAI	DSP	ELAI	IAI	IAII
ADAI1	0,759	0,427	0,324	0,380	0,356
ADAI2	0,791	0,427	0,300	0,351	0,402
ADAI3	0,856	0,523	0,383	0,441	0,487
ADAI4	0,868	0,525	0,438	0,435	0,511
ADAI5	0,810	0,529	0,490	0,426	0,497
ADAI6	0,678	0,589	0,649	0,625	0,738
DSP-1	0,525	0,817	0,632	0,415	0,628
DSP-2	0,436	0,766	0,636	0,493	0,633
DSP-3	0,484	0,734	0,492	0,261	0,542
DSP-4	0,549	0,755	0,482	0,419	0,560
DSP-5	0,518	0,817	0,617	0,430	0,578
ELAI-1	0,564	0,741	0,938	0,518	0,756
ELAI-2	0,461	0,615	0,909	0,460	0,693
IAI3	0,489	0,275	0,199	0,626	0,276
IAI4	0,410	0,424	0,487	0,780	0,480
IAI5	0,388	0,458	0,436	0,843	0,502
IAI6	0,524	0,417	0,399	0,781	0,477
IAI7	0,420	0,401	0,464	0,790	0,484
IAII-1	0,488	0,616	0,681	0,535	0,812
IAII-2	0,544	0,602	0,605	0,475	0,853
IAII-3	0,627	0,696	0,615	0,413	0,832
IAII-4	0,547	0,606	0,669	0,503	0,875
IAII-5	0,491	0,645	0,728	0,552	0,823



**Figure 1.** PLS Estimation Results

Table 6 shows the designed hypotheses of this study and the results obtained from SEM analysis.

**Table 6.** Summary of Hypothesis Test Results

Path	Hypotesis	Path Coefficient ( $\beta$ )	p-Value	Decision
IAI -> DSP	H1	0,063	0,470	Positive and insignificant
ADAI -> DSP	H2	0,282	0,003	Positive and significant
IAII -> DSP	H3	0,257	0,014	Positive and significant
IAI*ELAI ->DSP	H4	-0,027	0,560	Not positive and not significant
ADAI*ELAI ->DSP	H5	0,190	0,023	Positive and significant
IAII*ELAI -> DSP	H6	-0,117	0,146	Not positive and not significant
ELAI -> DSP	H7	0,305	0,001	Positive and significant

Based on Table 6, it is known that the Path Coefficient value (Original Sample) of H2, H3, H5 and H7 has a positive value, which means it has a positive effect. However, H4 and H6 are negative, meaning that the IAI and ADAI variables do not have a positive effect on DSP when moderated by ELAI. In addition, H1 is positive but has no significant effect.

In addition, it is known that the p-value of H2, H3, H5 and H6  $<0.05$ , so it is concluded that these four hypotheses have a significant effect. However, H1, H4 and H6 have no significant effect because the p-value  $> 0.05$ :

Based on the results, there are 3 things that can be concluded, namely:

- H2, H3, H5 and H7 are positive and significant so that these four hypotheses can be accepted
- H1 is positive but insignificant so this hypothesis cannot be accepted
- H4 and H6 are not positive although they are significant so this hypothesis cannot be accepted.

As shown in Figure 1 and Table 5, the structural model analysis also documents the ability of the R-squared or all independent variables to explain the variance of the dependent variable. The analysis results show an acceptable level of variance of the lecturer trust model (68.8%). This means that there is 31.2% (100% - 68.8%) of the variance of the dependent variable explained by other factors which can be seen in the Table 7.

Table 7. R-Square

	R Square	R Square Adjusted
DSP	0,688	0,673

### 3.4. Discussion

The findings of this study provide valuable insights into the relationship between AI literacy and data security and privacy in blended learning models in higher education. The results show that different aspects of AI literacy have different impacts on data security and privacy.

First, this study shows that AI literacy has a positive but insignificant effect on data security and privacy. This implies that having a basic understanding of AI may not significantly impact data security and privacy in a blended learning model. However, it is still important to introduce students to AI concepts to ensure they have a basic understanding of the technology (Jiang et al., 2020). On the other hand, the study revealed that AI Advantages and Disadvantages literacy had a positive and significant effect on data security and privacy. This suggests that a deeper understanding of the benefits and risks associated with AI can contribute to better data security and privacy practices in a blended learning model. Educating students about the advantages and disadvantages of AI can help them make informed decisions and take appropriate actions to protect data (Guan et al., 2023).

Moreover, this study highlights the positive and significant effects of the implications of Artificial Intelligence literacy on data security and privacy. This implies that understanding the implications of AI in the context of data security and privacy is crucial to ensure the protection of sensitive information in blended learning models. By being aware of the potential risks and consequences, educators and students can implement appropriate safeguards and practices (Tapalova & Zhiyenbayeva, 2022). This study also identified a positive and significant influence of Artificial Intelligence Advantages and Disadvantages on data security and privacy moderated by Artificial Intelligence Ethics and Law. This suggests that the impact of AI literacy on data security and privacy is influenced by

ethical considerations and legal frameworks. It is important to educate students on the ethical and legal aspects of AI to ensure responsible and safe use of data in blended learning models (Loftus et al., 2022).

In addition, this study highlights the significant positive effects of Artificial Intelligence Ethics and Law on data security and privacy. This emphasizes the importance of incorporating ethical principles and legal regulations into AI literacy education to protect data in blended learning models. By understanding and adhering to ethical and legal guidelines, educators and students can reduce risks and protect sensitive information (Yi & Li, 2022). This study revealed a significant positive effect of Introduction to Artificial Intelligence on data security and privacy. This suggests that providing students with an introductory course on AI can contribute to better data security and privacy practices in a blended learning model. By equipping students with a basic understanding of AI, they can make informed decisions and take appropriate actions to protect data (Xu et al., 2022).

However, this study also identified that the significant positive effect of the introduction of artificial intelligence on data security and privacy moderated by Artificial Intelligence Ethics and Law was not positive, although significant. This suggests that the hypothesis that the effect of AI literacy on data security and privacy is moderated by ethical considerations and legal frameworks cannot be accepted. Further study is needed to explore the complex relationships between AI literacy, ethics, law, and data security and privacy in blended learning models (Qiu et al., 2019). The findings of this study highlight the importance of AI literacy in ensuring data security and privacy in blended learning models in higher education. Although AI literacy may have an insignificant effect, a deeper understanding of AI advantages and disadvantages, implications, and ethical considerations can significantly contribute to better data security and privacy practices. Educators and students should be equipped with the necessary knowledge and skills to protect sensitive information and comply with ethical and legal guidelines in the context of AI in blended learning models.

#### 4. Conclusion

Based on the results of the study, several things can be concluded that Artificial Intelligence Literacy has a positive, though not significant, effect on data security and privacy. This indicates that prior knowledge of artificial intelligence can positively contribute to an understanding of data security and privacy, although the impact may not be as strong. Artificial Intelligence Advantages and Disadvantages literacy has a positive and significant effect on data security and privacy. This suggests that a deeper understanding of the benefits and risks of artificial intelligence can have a positive and significant impact on efforts to maintain data security and privacy.

In addition, Artificial Intelligence Literacy Implications has a positive and significant effect on data security and privacy. This suggests that an understanding of the implications of using artificial intelligence can influence policies and practices relating to data security and privacy. There is a positive and significant effect of Advantages and Disadvantages of Artificial Intelligence on data security and privacy moderated by Ethics and Law of Artificial Intelligence. This suggests that factors such as ethics and law in artificial intelligence can moderate the relationship between understanding advantages and disadvantages and data security and privacy.

There is a positive and significant effect of Artificial Intelligence Ethics and Law on data security and privacy. This indicates that a better understanding of the ethical and legal aspects of artificial intelligence can contribute positively and significantly to efforts to maintain data security and privacy. There is a significant positive effect of Introduction to Artificial Intelligence on data security and privacy. This suggests that understanding the basics of artificial intelligence can also make a positive and significant contribution to understanding and practices related to data security and privacy.

This study only covers the variables of artificial intelligence literacy and data security and privacy. Other factors that may affect data security and privacy may not have been thoroughly considered. In addition, hypotheses that were not accepted in the study (such as in the case of the introduction of artificial intelligence) indicate the need for further study to better understand the phenomenon.

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