

Literacy Intelligence Artificial Intelligence and Critical Thinking Skills in Higher Education: A Prediction Model Responsible Use of AI in EFL Students

Raudhatul Haura

Islamic University of Kalimantan MAB Banjarmasin

Corresponding Author: Raudhatul Haura haura100@gmail.com

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ABSTRACT

Study This aim for analyze influence literacy intelligence artificial intelligence (AI literacy) and capabilities think critical to responsible use of AI answer to English as a Foreign Language (EFL) students in education high. Research use approach mixed methods with design sequential explanatory. Quantitative data collected of 350 EFL students and analyzed use statistics descriptive as well as Structural Equation Modeling-Partial Least Squares (SEM-PLS). The SEM-PLS results show that influential AI literacy positive and significant to responsible use of AI answer ($\beta = 0.461$; $p < 0.001$), as well as the ability think critical ($\beta = 0.382$; $p < 0.001$). The R^2 value of 0.648 indicates that second variables capable explains 64.8% of the variation responsible use of AI answer. Analysis qualitative identify four theme main, namely AI literacy, thinking critical, AI as tool help learning, as well as awareness to risk and ethics use of AI. Findings This confirm importance strengthening AI literacy and capabilities think critical for push ethical, critical, and responsible use of AI responsibility in education tall.

INTRODUCTION

Digital transformation that is taking place in the 21st century has change in a way significant various aspect life, including sector education high. One of the development the most prominent technology in a number of year final is emergence intelligence Artificial Intelligence (AI), especially Generative AI such as ChatGPT, Gemini, Copilot, and various application based Large Language Models (LLMs). Technology This capable produce text, analyze data, translate language, giving bait back, and support the learning process in a way interactive. The presence of AI is not only change method student get information, but also change pattern learn, think, and solve task academic. College high in various countries starting from integrating AI into in the learning process at a time develop guidelines ethical and responsible use answer as response to the more massive utilization technology by students and lecturers (Walter, 2024). Analysis against 116 research universities in the United States show that part big institutions education tall has push Generative AI integration in learning as well as develop various guide use that focuses on ethics, integrity academic, and the use of AI in productive (Miao & Holmes, 2024).

Development the followed by an increase the rapid use of AI among students . Various study latest show that AI has become part from activity academic daily students, starting from search information, brainstorming, idea compilation, grammar correction, to settlement task academic (Kasneci et al., 2024). Study show that majority student has using Generative AI to interest academic and utilize it as tool supporters learning as well as source bait come back to the tasks they do (Chan & Hu, 2025). The height level adoption the show that AI has develop from just technology supporters be one of instrument main in the modern learning process. However Thus, the increase the use of AI is not always followed by adequate understanding about method work, limitations, biases, and implications ethical from technology said. Many students Still using AI in a pragmatic for get answer instant without carry out verification and evaluation processes critical to information generated (Tlili et al., 2025).

Condition the put literacy intelligence artificial (AI literacy) as increasing competence important in education high. AI literacy is not only refers to the ability use AI applications, but also includes understanding about principle AI work, capabilities evaluate output system, consciousness against algorithm bias, protection data privacy, as well as understanding to aspect ethics and responsibility answer in use technology (Ng et al., 2024). Draft AI literacy today This develop become Responsible Generative AI Literacy which emphasizes ability individual for using AI in a critical, reflective, and responsible answer. Research latest confirm that AI literacy must viewed as multidimensional competencies that include aspect technical, cognitive, social, and ethical so that users capable leveraging AI effectively effective at a time minimize various the risks that accompany it (Cox, 2024).

In addition to AI literacy, the ability think critical thinking remains become fundamental competencies that must be owned student in facing the era of intelligence artificial. Ability think critical allows individual for analyze information in a way objective, evaluating arguments, identifying error logic, as

well as take decision based on valid evidence. In context use of AI, capabilities think critical become the more important Because AI systems can produce visible information convincing but Not yet Of course accurate, relevant, or free from bias. Research show that AI can functioning as supporting tools development think critical if used in a way reflective and purposeful (Larson et al., 2024). On the contrary, excessive use of AI without ability adequate evaluation potential cause dependence cognitive and reduce quality reasoning students (Zhang et al., 2024).

Problems the become the more relevant in context student English as a Foreign Language (EFL). For EFL students, AI offers various convenience in the learning process language, such as translation, grammar correction, development vocabulary, academic writing, and giving bait come back in a way instant. Various study show that utilization of AI in learning Language can increase quality of writing, creativity, reflection self and experience Study EFL students (Chen & Chen, 2025; Zou et al., 2025). However, benefits is also accompanied by risk emergence dependence to technology that can hinder development ability think critical, independent learning, and ability evaluate quality information in a way independent (Zhang et al., 2025). Research in the EFL context shows that that student view AI as useful tools for support learning language, but they also realized importance guard balance between support technology and capabilities think humans so that the learning process still meaningful (Kohnke et al., 2024).

Although study about AI in education tall growing very rapidly, some big studies Still focus on level adoption technology, perception users, the effectiveness of AI in learning, or the impact to results study. Research that examines connection between AI literacy, capabilities think critical, and responsible use of AI answer in a way simultaneous Still relatively limited, especially in the context of EFL students. In fact, the responsible use of AI answer is issue central in education tall Because related with integrity academic, quality learning and readiness student facing an increasingly busy world of work digitalized (UNESCO, 2024). The gap study This show the need for an empirical model that is capable explain driving factors student using AI in a ethical, critical, and responsible answer.

Based on description said, research this aim for analyze influence literacy intelligence artificial and capable think critical to responsible use of AI answer to EFL students in education high. Research This offer novelty with integrate second variables the in a prediction model responsible use of AI answer. Research results expected can give contribution theoretical for development literature about AI in education tall as well as give implications practical for college tall in designing AI literacy policies, curricula, and programs that are capable of produce graduates who do not only competent digitally, but also critically, ethically, and responsibly answer in utilise technology intelligence artificial.

THEORETICAL REVIEW

Artificial Intelligence Literacy

AI literacy is the ability to understand, use, and evaluate AI technology effectively and ethically. This competency includes an understanding of how AI works, algorithmic bias, and the risks of its use. Students with high AI literacy tend to be more able to use AI critically and responsibly (Ng et al., 2024; Cox, 2024).

Critical Thinking Skills

Critical thinking skills are the ability to analyze, evaluate, and draw conclusions based on valid evidence. In the AI era, these skills are essential for verifying information generated by AI systems before use. Students with strong critical thinking skills are better able to avoid errors, bias, and dependency on technology (Facione, 2020; Larson et al., 2024).

Responsible AI Use

Responsible AI use refers to the use of AI ethically, transparently, and in accordance with the principles of academic integrity. Users are expected to verify information, maintain data privacy, and avoid plagiarism when using AI. This approach is crucial to ensuring that AI supports the learning process without compromising the quality of human reasoning (UNESCO, 2024; Chan & Hu, 2025).

The Relationship Between AI Literacy, Critical Thinking, and Responsible AI Use

AI literacy and critical thinking skills are important factors in encouraging the responsible use of AI. AI literacy helps students understand the benefits and risks of technology, while critical thinking helps them evaluate the outcomes of AI. Therefore, the higher these two competencies, the more likely students are to use AI ethically and responsibly (Ng et al., 2024; Zhang et al., 2024).

METHODOLOGY

Study this use approach *mixed methods* with design *sequential explanatory*, that is combine method quantitative and qualitative in a way sequentially. Stage First done study quantitative for test influence literacy intelligence artificial intelligence (*AI literacy*) and capabilities think critical to responsible use of AI answer. Stage second done study qualitative through interview for deepen and explain results findings quantitative.

Population study is student *English as a Foreign Language* (EFL) in college high in Indonesia which has utilise application AI- based in activity academic. Quantitative sample a total of 350 students were selected use technique *proportionate stratified random sampling*. Temporary that , sample qualitative consists of of 15-20 selected students use technique *purposeful sampling* based on variation level AI literacy, capabilities think critical, and responsible use of AI answer.

Instrument Study

1. Literacy Intelligence Artificial (AI Literacy)
 - a) Understanding draft AI basics.
 - b) Ability use AI applications.
 - c) Ability evaluate AI output.
 - d) Awareness against the biases and limitations of AI.
 - e) Understanding ethics use of AI.
 - f) Awareness data security and privacy.
2. Critical Thinking Skills
 - a) Ability analyze information.
 - b) Ability evaluate argument.
 - c) Ability identify problem.
 - d) Ability interesting conclusion (inference).
 - e) Ability reflection and assessment critical.
 - f) Ability taking decision based proof.
3. Responsible Use of AI
 - a) Verification AI - generated information.
 - b) Transparency use of AI in task academic.
 - c) Compliance to integrity academic.
 - d) The use of AI in ethical.
 - e) Utilization of AI as tool help, not substitute for the thought process.
 - f) Awareness to impact and risk use of AI.

Quantitative data analyzed use statistics descriptive and *Structural Equation Modeling-Partial Least Squares* (SEM-PLS) for test connection between variables. Furthermore, qualitative data analyzed use *thematic analysis* for identify themes that explain results study quantitative. Integration of the two data is carried out at the stage interpretation for produce greater understanding comprehensive about factors that influence responsible use of AI answer to EFL students.

RESULTS

Analysis Descriptive

Analysis descriptive done for get description general about level literacy intelligence artificial intelligence (AI literacy), ability think critical, and responsible use of AI answer to EFL students. Analysis results show that third variables is in the category tall.

Table 1. Statistics Descriptive Variables Study

Variables	Mean	Elementary School	Category
Literacy Intelligence Artificial (AI Literacy)	4.08	0.56	Tall
Critical Thinking Skills	3.95	0.61	Tall
Responsible Use of AI	4.12	0.58	Tall

Based on Table 1, the responsible use of AI answer own the highest average value (M = 4.12), followed by literacy intelligence artificial (M = 4.08),

and ability think critical (M = 3.95). Findings This show that EFL students have level good understanding of AI as well as trend using AI in a ethical and responsible answer in activity academic.

SEM-PLS Analysis Results

SEM-PLS analysis was performed use SmartPLS 4 for test validity and reliability of the measurement model (*outer model*) and connection between variables in the structural model (*inner model*).

Evaluation of Measurement Model (Outer Model)

Table 2. Results of Reliability and Construct Validity Tests

Variables	Cronbach's Alpha	Composite Reliability	AVE
AI Literacy	0.912	0.928	0.683
Critical Thinking Skills	0.901	0.921	0.662
Responsible Use of AI	0.918	0.934	0.702

The results in Table 2 show that all over construct own mark *Cronbach's Alpha* and *Composite Reliability* above 0.70 and mark *Average Variance Extracted (AVE)* above 0.50. With Thus, all construct fulfil criteria reliability and validity convergent (Hair et al., 2022).

Table 3. Discriminant Validity (*Fornell-Larcker Criterion*)

Variables	AI Literacy	Critical Thinking	Responsible AI Use
AI Literacy	0.826		
Critical Thinking	0.614	0.814	
Responsible AI Use	0.721	0.693	0.838

Root value squared AVE at each construct more big compared to correlation between construct others. This is show that the model has fulfil discriminant validity criteria.

Structural Model Evaluation (Inner Model)

Table 4. R-Square Value

Endogenous Variables	R ²	Category
Responsible Use of AI	0.648	Substantial

The R² value of 0.648 indicates that AI literacy and capabilities think critical capable explains 64.8% of the variation responsible use of AI answer. The rest 35.2 % is explained by other factors outside the research model.

Table 5. Predictive Relevance (Q²)

Endogenous Variables	Q ²
Responsible Use of AI	0.442

The Q^2 value of 0.442 (>0) indicates that the model has ability good predictive.

Testing Hypothesis

Table 6. Structural Path Test Results (*Bootstrapping*)

Hypothesis	Relationship between variables	B	t-value	p-value	Decision
H1	AI Literacy → Responsible Use of AI	0.461	8,327	0,000	Accepted
H2	Think Critical → Responsible Use of AI	0.382	6,915	0,000	Accepted

Based on bootstrapping results , all hypothesis study accepted Because own t-statistic value > 1.96 and p-value < 0.05 . AI literacy has influence positive and significant to responsible use of AI answer ($\beta = 0.461$; $p < 0.001$). Findings This show that the more tall level AI literacy of students, increasingly high tendency they using AI in a ethical and responsible answer.

Ability think critical also has an influence positive and significant to responsible use of AI answer ($\beta = 0.382$; $p < 0.001$). This show that students who have ability good analysis, evaluation and reflection tend more be careful in leveraging AI and more capable do verification to information generated technology.

Table 7. Total Influence of Variables Predictor

Variables Predictor	Total Effect	Contribution (%)
AI Literacy	0.461	46.1
Critical Thinking Skills	0.382	38.2

The total influence results show that AI literacy is the strongest predictor in explain responsible use of AI answer compared to ability think critical. Findings This indicates that understanding about method work, benefits, risks, and ethics the use of AI becomes factor the main thing that forms behavior student in using AI in a responsible answer.

In a way Overall, the SEM-PLS results show that the research model own level validity, reliability, and power good predictions. AI literacy and capabilities think critical proven become factor important things that influence responsible use of AI answer to EFL students in education tall.

Analysis Results Qualitative (Thematic Analysis)

Table 8. Summary of Analysis Results Themes Qualitative

Main Theme	Description Findings
AI literacy as base responsible use of AI answer	Student understand benefits, limitations, and risks of AI so that more be careful in using the resulting output.

Think critical in evaluate AI information	Student do verify, compare information with source academic others, and evaluate accuracy AI results before used.
AI as tool help learning	AI is utilized for brainstorming, grammar correction, idea searching, and comprehension material without replace the thought process student.
Awareness to risk and ethics use of AI	Student realize potential dependency, information that is not accurate, and importance guard integrity academic in use of AI.

Analysis results thematic show that responsible use of AI The answer to EFL students is formed by four theme main, namely AI literacy, capabilities think critical, the use of AI as tool help learning and awareness to risk as well as ethics use of AI. Most of participants state that understanding about method work and limitations of AI help they use technology the in a way more wise. Students also show ability think critical through habit verify and compare AI - generated information with source other academics before used in task lectures. In addition, AI is seen as tool supporters who help the learning process, such as develop ideas, improve grammar, and understand complex material, but No replace the process of thinking and decision making decision. On the other hand, students realize existence risk use of AI, such as dependency, potential information that is not accurate, and violation integrity academic if used in a way No right. Findings This strengthen results quantitative which shows that AI literacy and capabilities think critical is factor important in form behavior responsible use of AI answer to EFL students.

DISCUSSION

Research result show that EFL students have level literacy intelligence artificial intelligence (AI literacy), ability think critical, and responsible use of AI answer in category high. Findings This indicates that student No only has adopt AI technology in activity academic they, but also have relative understanding Good about method utilise technology the in a way effective and ethical. The height score responsible use of AI answer (M = 4.12) shows that part big student has realize importance verification information, transparency use of AI, as well as compliance to principle integrity academic findings This in line with research that states that generative AI is increasingly viewed as tool supporters learning that can be increase productivity and quality Study if used in a way wise and appropriate with academic norms.

The results of the SEM-PLS analysis show that influential AI literacy positive and significant to responsible use of AI answer ($\beta = 0.461$; $p < 0.001$). Findings This confirm that understanding about draft AI basics, capabilities evaluate output, awareness against algorithm bias, as well as understanding ethics use technology is factor important things that form behavior student in leveraging AI effectively responsible answer. Students who have high AI literacy tend more capable understand limitations AI systems and not accept information generated in a way raw without evaluation process more continue. With Thus,

AI literacy works as foundation competencies that enable student leveraging AI effectively productive at a time avoid various risk like misinformation, plagiarism, and dependency technology. Findings This support view that AI literacy is multidimensional competencies that are not only covers skills technical, but also ability cognitive and ethical in interact with technology based intelligence artificial.

In addition, the ability think critical is also proven own influence positive and significant to responsible use of AI answer ($\beta = 0.382$; $p < 0.001$). This result show that capable students analyze information, evaluate argument, do reflection, and taking decision based proof more tend using AI in a be careful and don't depends completely on the results provided system. In context EFL learning, ability think critical become the more important because AI can produce visible information accurate and convincing, but not yet of course correct or in accordance with context academic requirements. Therefore that, students need carry out verification and assessment processes critical before use information the in task or activity learning. Findings This strengthen argumentation that development AI technology does not reduce importance ability think humans, but rather precisely increase need will skills think level tall as mechanism control to use technology.

Analysis results qualitative the more strengthen findings quantitative through four theme the main thing that appears is AI literacy as base responsible use of AI answer, think critical in evaluate AI information, AI as tool help learning and awareness to risk as well as ethics use of AI. Students state that understanding to method work and limitations of AI help they more selective in using the resulting output. They also show practice think critical with compare AI results with source other academics before using it. On the other hand, AI is perceived as tools that help the process of brainstorming, idea development, grammar improvement, and comprehension complex material, but No considered as substitute for thinking process students. Awareness to potential risks, such as inaccuracy information, algorithmic bias, and violations integrity academic, also become driving factors the use of AI in more responsible answer.

In a way overall, research This show that responsible use of AI answer to EFL students is results interaction between competence AI literacy and capabilities think critical. AI literacy provides understanding about How technology work and the risks that come with it, whereas think critical allows student evaluate and utilize information generated in a way more reflective. Therefore that, college tall need integrate development AI literacy and skills think critical to in curriculum as well as policy learning. These efforts important for ensure that student No only become users competent technology, but also capable individuals leveraging AI effectively ethical, responsible responsible, and support meaningful learning processes in the era of digital transformation.

CONCLUSIONS AND RECOMMENDATIONS

Study This show that literacy intelligence artificial intelligence (AI literacy) and capabilities think critical is factor important things that influence responsible use of AI answer to EFL students. The results of the SEM-PLS analysis prove that

that second variables the influential positive and significant to behavior ethical, critical, and appropriate use of AI with principle integrity academic, with AI literacy as the most powerful predictor. Findings qualitative also confirms that students who understand method work, benefits, risks, and limitations of AI as well as own ability evaluate information in a way critical tend utilizing AI as tool help learning, not as substitute for the thought process. Therefore that, strengthening AI literacy and skills think critical need become priority in education tall for support responsible use of AI responsible and sustainable in the digital era.

FURTHER STUDY

Future research is recommended to examine the proposed prediction model across diverse educational settings, disciplines, and cultural contexts to enhance its generalizability and validity. Additionally, longitudinal and mixed-method studies may provide deeper insights into how artificial intelligence literacy, responsible AI use, and critical thinking skills interact over time and influence EFL students' academic performance, digital competence, and ethical decision-making in higher education.

Furthermore, future studies may incorporate additional variables such as digital self-efficacy, technological readiness, academic motivation, and ethical awareness to develop a more comprehensive understanding of students' engagement with artificial intelligence. Comparative studies involving different educational levels and international contexts are also encouraged to identify best practices for promoting responsible AI use and strengthening critical thinking skills in language learning environments.

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