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Exploring the Relationship of AI Literacy with Critical Thinking and Problem-Solving Skills of Students in Higher Education

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ABSTRACT

Artificial Intelligence (AI) literacy has emerged as an essential competency for higher education students in an era of rapid technological advancement. This study investigated the relationship between AI literacy and students' critical thinking (CT) and problem-solving skills (PSS). A quantitative research design was employed using a structured survey administered to students from various academic disciplines in higher education institutions. A stratified random sampling technique was used to select a sample of 300 students representing diverse educational backgrounds. The research instruments measured students' levels of AI literacy, critical thinking, and problem-solving skills. Descriptive statistics were used to determine the overall levels of the study variables, while correlation and regression analyses were conducted to examine the strength and nature of the relationships among them. Data were analyzed using the Statistical Package for the Social Sciences (SPSS).The findings revealed a significant positive relationship between AI literacy and both critical thinking and problem-solving skills. Furthermore, regression analysis indicated that AI literacy is a significant predictor of students' higher-order cognitive abilities. The results suggest that students with higher levels of AI literacy are more likely to demonstrate stronger analytical, evaluative, and problem-solving capabilities. This study contributes to the growing body of literature on AI in education by highlighting the importance of integrating AI literacy into higher education curricula. Promoting AI literacy can enhance students' cognitive development, critical thinking, and problem-solving abilities, thereby preparing them more effectively for academic success and future professional challenges in an AI-driven world.

1. Introduction

Artificial Intelligence (AI) is a part of the modern society and has had a profound impact on various fields, including education, healthcare, industry, and the decision-making process. Among the technologies based on AI, intelligent tutoring or chatbot systems, adaptive learning platform, and learning analytics are becoming increasingly used in the context of higher education to improve the efficiency of teaching and student learning experiences (Holmes et al., 2019; Zawacki-Richter et al., 2019). Due to the increased contact of students with these technologies, the acquisition of AI literacy has become an essential skill of academic success and lifelong learning. AI literacy is the knowledge of the basic ideas of AI, the skills of students to operate the AI-based tools in a responsible and efficient way, and their knowledge of the ethical, social, and cultural conditions of artificial intelligence (Long and Magerko, 2020). More AI-literate students will be in a better position to assess AI-generated information critically and doubt the algorithmic production, as well as informed choice in the use of AI technologies in the academic and real life environment (Ng et al., 2021). Problem-solving and critical thinking are commonly viewed as key educational outcomes in universities. Critical thinking allows students to process information and analyze facts, effectively draw conclusions, whereas problem-solving skills can help them define issues, find alternative and practical solutions, and apply them (Facione, 2015). As the use of AI-based tools in the learning and academic activities is becoming more and more frequent, one should be able to understand how AI literacy can help to foster the development of these higher-order cognitive capabilities. Thus, the proposed research is going to investigate the correlation between AI literacy, critical thinking, and problem-solving skills among higher-education students.

The conceptual framework shows how the AI Literacy and Critical Thinking Skills, and Problem-Solving Skills relate among higher education students. It describes how the knowledge and skills of students in the use of artificial intelligence machines could help them build skills of high order thinking. The framework also emphasizes the role of AI literacy to be able to assist students in critically analyzing information, making sound judgments and resolving complex problems in academic settings. The framework offers three primary dimensions of AI Literacy, such as cognitive, technical/functional, and ethical competencies. These dimensions reflect the knowledge of students about the idea of AI and their skills in the effective usage of AI tools, as well as their consciousness in applying AI technologies to ethical issues. The competencies assist students in gaining higher skills in thinking which is critical in contemporary learning facilities. Conceptual framework introduces two key relationships: Individuals have acquired skills in AI literacy to critical thinking, including the ability to identify the limitations of AI usage in decision-making and the potential to implement this technology in practical scenarios.

(a) AI Literacy to Critical Thinking Skills: The AI literacy will have a positive effect on the critical thinking of students. Students who are also familiar with AI concepts and aware of how to use AI tools are able to analyze the information better, assess the AI generated output and make logical decisions. This process helps to reinforce relevant elements of critical thinking including analysis, evaluation, and reasoning.

(b) AI Literacy to Problem-Solving Skills: The model also suggests that AI literacy has a direct correlation with problem-solving skills. Students who have high levels of AI literacy are better positioned to utilize digital tools and smart systems to diagnose and find solutions to the problem, as well as make quality decisions. Their technological and moral knowledge of AI allows them to use complex academic assignments in a more strategic and efficient manner.

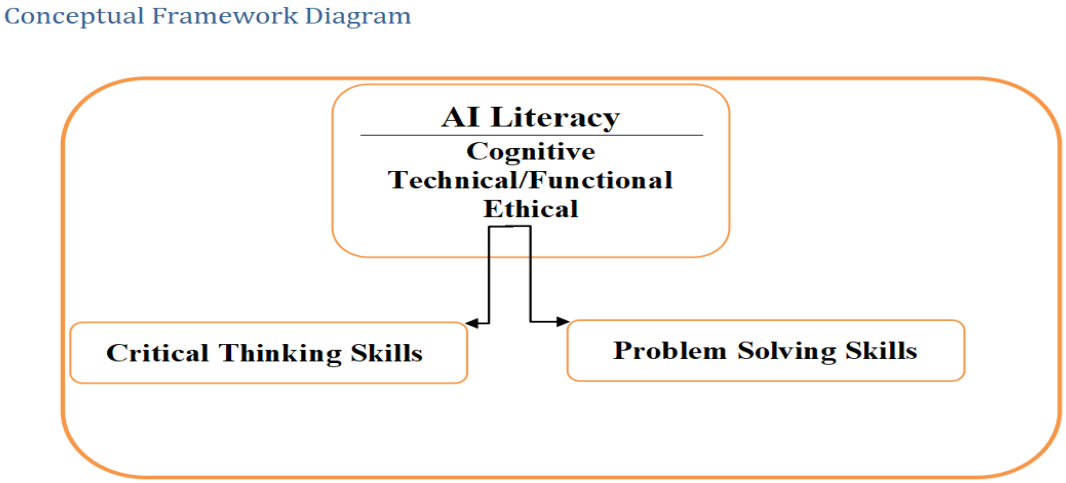

Figure 1 ***Conceptual Framework of the Study***

2. Literature Review

The concept of AI literacy has been defined as a multidimensional object that includes technical knowledge, skills of hands-on application, and ethical consciousness with respect to artificial intelligence (Long and Magerko, 2020). According to researchers, AI literacy will allow learners to approach intelligent systems in a critical and reflective way instead of passively receiving AI-generated outputs (Kong et al., 2021). Empirical literature shows that better-prepared students in terms of AI literacy show better judgment, more awareness of the digital world, and high analytical thinking abilities (Ng et al., 2021). Critical thinking can be generally described as an skill of providing logical and systematic analysis, synthesis, and evaluation of information (Facione, 2015). Past studies also suggest that learning communities rich in technology may promote critical thinking in situations where students approach the use of digital technologies in an active manner, and contemplate their application, instead of using them in a rather passive and uncritical manner (Lai and Bower, 2019). Thoughtfully applied AI-based learning tools can help in fostering critical thinking by making learners doubt their assumptions, challenge the sources of information, and consider various points of view (Holmes et al., 2019). Problem-solving skills entail problem identification, applying the knowledge related to the problem, and creating efficient and creative solutions (Jonassen, 2011). Research has demonstrated that learning platforms that facilitate problem-solving skills in students can be improved through online and artificial intelligence through simulations, adaptive feedback, and dynamic data processing (Spector, 2014). Also, the studies indicate that, in the absence of proper AI literacy, students will not be able to use them in the most effective way or can be dependent on AI systems without knowing the processes behind the problem, which can restrict the building of independent problem-solving abilities (Kong et al., 2021). Even though it is true that research has been conducted to determine the relationship between digital literacy, critical thinking and problem-solving skills, there is still little research done on the topic of AI literacy and how it affects the development of these cognitive abilities in higher education. The literature gap allows identifying the necessity of the empirical exploration of the relationship between AI literacy and critical thinking and problem-solving skills in the case of university students.

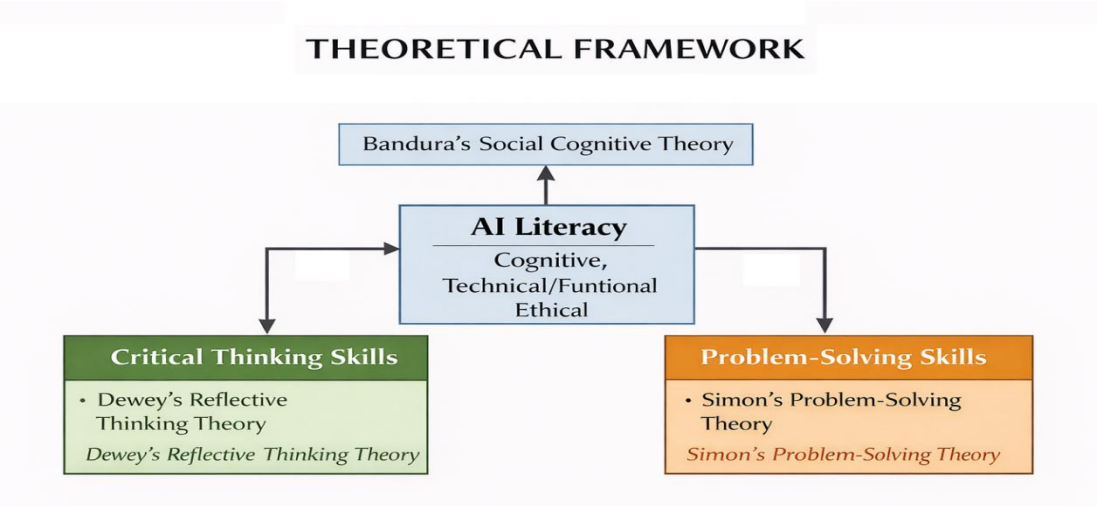

Figure 2 ***Theoretical Framework of the Study***

3. Objectives of the Study

1. Examine the relationship between AI literacy and critical thinking skills among higher education students.
2. Investigate the relationship between AI literacy and problem-solving skills among higher education students.

4. Methodology

4.1 Research Design

A quantitative correlational research design was used to explore the relationship between AI literacy, critical thinking, and problem solving skills. This design was appropriate as it allowed the researcher to examine relationships among variables without manipulation.

4.2 Population and Sample

The research sample comprised of undergraduate and post graduate learners in a state-owned universities in Pakistan. The sample size (300 students) was determined by the convenience sampling method that is almost always used in the research that involves education-related research studies since the sample size of people, who can be accessed, is restricted. Social sciences, humanities, and technical subjects were represented in the sample, consisting of students of the departments of engineering, social sciences, computer science, and business where the case of the application of AI tools is on the rise. Both male and female students of both urban and rural origin took part in the study, which was able to represent larger demographics.

4.3 Research Instruments

The data is gathered through a straightforward questionnaire that was developed for this research. The instrument includes a 5-point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) to rate AI literacy, critical thinking, and problem-solving skills with an additional demographic section. Survey was design to convert the literature into Pakistani context, and then clarify for using the hidden educational setting (Ng et al., 2021).

Section A gathered demographic information with a structured format: gender (female, male), type of university (public, private), discipline (e.g., engineering, social sciences). This section

made it possible to stratify and control confounders, thus, increasing the study's analytical depth and its accordance with the conceptual model's contextual factors (Scherer et al., 2024). The questionnaire was pilot-tested with 50 students to ensure that they were culturally appropriate and clear, which led to the production of minor changes (target Cronbach's $\alpha > 0.80$ for all sections).

4.4 Validity and Reliability

validity of the instrument was supported through content validation by experts (Six education researchers) who evaluated the items on a 5-point Likert scale (Strongly Agree, Agree, Neutral, Disagree, Strongly Disagree) in order to determine the relevance, clarity, and necessity of the items, as detailed in the expert validation guidance and consistent with the conceptual model. Factor analysis basically (KMO > 0.7, Bartlett's $p < 0.001$) was used to confirm construct validity.

Convergent validity is estimated with AVE > 0.5 (Fornell & Larcker, 1981; supported by Hair et al., 2021). Reliability was confirmed through Cronbach's α (>0.70 for all parts) and test-retest on a subsample ($r > 0.80$). These are the measures that conform to strict quantitative standards in education (Messick, 1995; American Educational Research Association, 2014, updated). Recent AI literacy research has identified such validations as means to guarantee the measurement's accuracy and to be consistent with the conceptual model (Ng et al., 2021; Laupichler et al.,2022).

4.5 Expert Opinion

Six academic experts from education department were asked for their thoughts. They offered suggestions regarding the ease of understanding each question as well as how well the questionnaire relate to the study. The authors' advice led to redundant questions being taken out and the questionnaire was improved for clarity and accuracy.

4.6 Data Collection Procedure

Data were collected online through Google Forms between September and October 2025, after receiving ethical approval from the institutional review board. Researchers used university email lists and social media groups to get in touch with potential participants. Participants digitally agreed to the informed consent. The questionnaire was done in 20-30 minutes. Reminders were sent one week after the first contact to increase the response rate (target 70%). Anonymity was assured to the participants, and the data were stored in a safe place on password-protected servers to respect the participants' privacy (Suri & Clarke, 2024).

4.7 Data Analysis

The analysis of data was done in Statistical Package of Social Sciences (SPSS). Descriptive statistics (means and standard deviations) were calculated to provide an overview of the measures of AI literacy,critical thinking and problem solving skills of students. The relationships of the variables were analyzed by Pearson product-moment correlation. Simple and multiple regression tests were used to establish the predictive strength of AI literacy,critical thinking and problem solving skills. The level of statistical significance was established at $p < .05$.

5. Results

The results revealed a significant positive relationship between AI literacy and critical thinking skills. Students with higher levels of AI literacy demonstrated stronger analytical and evaluative abilities. Similarly, AI literacy showed a significant positive relationship with problem-solving skills, indicating that AI-literate students were more effective in identifying and solving academic problems.

Regression analysis indicated that AI literacy significantly predicted both critical thinking and problem-solving skills. These findings suggest that AI literacy plays an important role in developing higher-order cognitive skills among higher education students.

Demographic Profile

The following is the demographic profile of the study:

Table 1: ***Demographic Profile of the Study***

Variable Name	Category	Frequency	Percent
Gender	Male	109	36.3
	Female	191	63.7
	Total	300	100.0%
Institution	public	161	53.7
	private	139	46.3
	Total	300	100.0%
Department	Education	97	32.3
	Information technology	106	35.3
	Engineering	97	32.3
	Total	300	100%

Table 2: Reliability Analysis of Study Constructs

Measure	Number of Items	Cronbach's α
AI Literacy, Critical Thinking Skills, Problem-Solving Skills	3	.975

Note. Cronbach's alpha values above .70 indicate acceptable internal consistency

The characteristics of the study variables were summarized using descriptive statistics (refer to table 3 below). The average score for AI tool usage was 1.50 (SD = 0.50), which is indicative of a moderate level of the AI tool usage by the respondents. The gender variable recorded a mean of 1.64 (SD = 0.48), which is a fairly balanced gender distribution. The mean of the gender variable was 1.64 (SD=0.48), which indicated a fairly balanced gender distribution. Likewise, the type of the institution variable had a mean of 1.46 (SD = 0.50), implying that the respondents were nearly equally distributed between the two categories of the institutions. These descriptive statistics provide evidence of a sufficiently large and varied sample, which is suitable for subsequent inferential analysis.

Table 3: Descriptive Statistics of Study Variables (N = 300)

Variable	Minimum	Maximum	Mean (M)	Standard Deviation (SD)
AI Literacy (AI Tool Usage)	1	2	1.50	0.50
Gender	1	2	1.64	0.48
Institution Type	1	2	1.46	0.50

Note. Values represent coded responses used for analysis.

Pearson correlation analysis was employed to figure out the strength as well as the direction of the relationship between the core constructs that came from the questionnaire, i.e. AI literacy, critical thinking skills, and problem, solving skills, along with the respective item sets. The three different

aspects, cognitive, technical/functional, and ethical/socio, cultural, were the AI literacy dimensions through which the latter was gauged, while critical thinking and problem, solving skills were the students' self, reported analytical, reflective, and solution, oriented behaviors.

The first result indicates a significantly strong and statistically positive correlation between overall AI literacy and critical thinking skills ($r = .998$, $p < .001$). Another result was that the students who not only comprehended the concepts of AI in a profound way but also knew about its constraints and dangers and could even consider how AI influences learning were the students who are likely to think critically, ask questions, reason, or even evaluate the validity of information sources. This strong correlation points to the fact that the conceptual contribution of AI literacy and higher, order thinking is conceptually very close, particularly, in the academic field where the successful application of AI must involve reflective judgment and evaluative thinking. In addition to that, the studied data revealed that the correlation between AI literacy and problem-solving skills was strong and positive. The statistical analysis that has been supported by the data is $r = .938$, $p < .001$. This is a good manifestation of the close relationship. The respondents who self-identified themselves as users of AI tools in academic assignments, data analysis, research, and problem-solving and groups many and most of the time also happened to display the increased level of problem definition, solution-generating, alternative-evaluating, and strategy-changing when initial solutions failed. The fact mentioned by the association is that proficient AI student can better opine AI tools as a structured and strategic problem solving tools, which enhances their level of cognitive engagement and academic achievement. Further, the critical thinking skills were positively and strongly associated with problem-solving skills, which was an indication of the interdependent nature of the cognitive abilities ($r = .937$, $p < .001$). Students that were involved in reflective thinking, logical reasoning, and evidence analysis were the most effective in their solution of and management of complex academic problems, which, in its turn, implies that the mentioned abilities are acquired simultaneously in AI-mediated learning settings. As opposed to the specified demographic variables, such as the gender, did not demonstrate any statistically significant relationships with each of the variables. The observation indicates that the revealed relationships do not depend on gender disparity but are the consequence of cognitive activity of students and their relationship with AI technologies. Accordingly, correlation analysis is a strong piece of empirical evidence of the conceptual framework of the study, which is in line with the strong connection between AI literacy and the basic higher-order cognitive skills in tertiary education.

Table 4: Pearson Correlation Matrix of Main Study Variables

Variable	**1**	**2**	**3**
1. AI Literacy	1		
2. Critical Thinking Skills	.998**	1	
3. Problem-Solving Skills	.938**	.937**	1

Note. **p < .01 (two-tailed).

In order to better understand how well critical thinking and problem-solving skills could predict the use of AI tools, a multiple regression analysis was performed (see Table 4).

The regression model was statistically significant, $F(2, 297) = 31, 998.44$, $p < .001$, thus indicating a good fit of the model to the data. The model explained 99.5% of the variation in AI tool usage ($R = .995$), which implies that the predictors combined gave an almost perfect account of the changes in AI tool usage.

Among all the variables, critical thinking skills were the strongest predictor of AI tool usage (= .972, t = 86.06, p < .001), meaning that it was the main factor that caused the increased interaction with AI tools. Problem-solving skills also accounted for a significant portion of the variation in the model (= .027, t = 2.38, p = .018), but their contribution was relatively small compared to that of critical thinking skills.

Table 5: Multiple Regression Analysis Predicting AI Literacy

Predictor	**B**	**SE B**	**β**	**t**	**p**
Constant	-0.057	0.029	—	-1.98	.049
Critical Thinking Skills	0.974	0.011	.972	86.06	< .001
Problem-Solving Skills	0.038	0.016	.027	2.38	.018

Note. R = .998, R^2 = .995, Adjusted R^2 = .995, F(2, 297) = 31,998.44, p < .001.

One, sample t, tests were used to find out if the average scores of AI tool usage, critical thinking skills, and problem-solving skills are significantly different from zero (See table 5 below). The findings of analyzed data in terms of relationship, highlighted that all three variables were statistically significant at p < .001. The large tt-valuesfor all the constructs indicate that the respondents have evidently used AI tools more and demonstrated higher levels of critical thinking and problem-solving skills.

Moreover, the effect size analysis indicated very large practical effects with Cohen's d values far exceeding the standard limits for large effects. This means that the differences that have been detected are not only statistically significant but also have a considerable impact in real terms.

Table 6: **One-Sample t-Test Results for Study Variables**

Variable	**t**	**df**	**p (two-tailed)**	**Mean Difference**	**95% CI**
AI Literacy	65.81	299	< .001	3.92	[3.80, 4.04]
Critical Thinking Skills	65.96	299	< .001	3.92	[3.81, 4.04]
Problem-Solving Skills	97.04	299	< .001	4.09	[4.01, 4.18]

Note. Test value = 0.

The study hypotheses were evaluated using the correlation and regression results. The data confirmed the first hypothesis, which indicated a significant relationship between AI literacy (AI tool usage) and critical thinking skills. A strong statistically significant positive correlation was found. Hence, the null hypothesis has been rejected, however, the alternative hypothesis was accepted.

Moreover, the second hypothesis of the study that pointed to a significant relationship between AI literacy and problem, solving skills was also corroborated by the results. The strong positive correlation and the significant regression coefficient resulted in the rejection of the null hypothesis and the acceptance of the alternative hypothesis.

The findings of this chapter provide strong empirical support for the proposed research model. The results demonstrate that critical thinking skills and problem, solving skills are not only significantly related to but also can be used to predict AI tool usage among university students. The extremely high explanatory power of the regression model draws attention to the role of cognitive skills in students' engagement with AI technologies.

6. Findings

The following findings were made: The research was done to a sample of 300 tertiary education students. The higher percentage of the respondents were female compared to male students, meaning that there is a high female involvement in higher education. Different disciplines were represented because the students were enticed in different academic backgrounds and institutions. Students with different academic performance were included; however, the range of CGPA was equally distributed. This population diversity made the findings to be more generalizable to the higher education situation. The results showed that the level of AI literacy was rather high among the students. The majority of respondents mentioned that they regularly used generative AI, digital research assistants, and intelligent learning platforms as academic tools that are based on AI. Students were conscious of the operation of AI, ethical issues, and the necessity of the critical analysis of AI-generated outputs. This implies that AI literacy is not just limited to the basic technical application but also cognitive application of AI tools amongst higher education students. It was discovered that there was a very high and statistically significant positive relationship between AI literacy and critical thinking skills (r =.998, p= less than 0.001). This result indicates that students with a greater level of AI literacy have more opportunities to analyze information, assess the credibility of available sources, doubt the output of AI, and make sufficient scholarly conclusions. The findings validate that the application of AI tools facilitates the use of higher-order thinking processes, which are constructivist and cognitive theories of learning. The correlation analysis showed that AI literacy and problem-solving skills were highly positive (r =.938, p <.001). Active users of AI tools showed a higher level of problem recognition, search of alternative solutions, and improvement of responses due to iterative learning. The learning environments based on AI seemed to develop an organized way of thinking and decision-making, which contributed to academic problem-solving skills to a considerable extent in students. The results also demonstrated that critical thinking and problem-solving skills have a significant and statistically significant positive correlation (r =.937, p <.001). Students who possess strong critical thinking skills were better in academic problem solving meaning that the two cognitive skills are highly interlinked and occur together, especially in cases of AI-integrated learning.

The regression analysis showed that the two factors (critical thinking and problem-solving skills) explained 99.5% of the variance in AI literacy (R =.995, F(2, 297) =31, 998.44, p <.001). Among the predictors, the strongest predictor of the AI literacy was critical thinking skills (0.972, p <.001) and problem-solving skills also indicated the presence but to a lesser extent (0.027, p =.018). This observation emphasizes that AI literacy is mainly cognitive competence based, and not technical skills. The outcome of the one-sample t-test showed that all of the aforementioned variables, such as AI literacy, critical thinking skills, and problem-solving skills, had significantly higher values than the test value with large effect sizes at p <.001. This proves that the students who took part in the sample were quite engaged in cognition and made significant use of AI tools. The results confirm the opinion that AI literacy is a complex cognitive ability that strengthens reflective learning, analytical thinking, and performance in problem solving. Though the results can be considered a powerful empirical evidence on the proposed research framework, the very high correlation rates between variables indicate that AI literacy and cognitive skills are closely related in terms of their concepts. This could have resulted in inflated relationships by the dependence on self-reported data and the use of cross-sectional research design which limits the causal interpretation. On the whole, the results prove that AI literacy is positively and significantly related to the critical thinking and problem solving skills in higher educators. The research shows AI literacy is a cognitive concept that facilitates higher-order learning and not just a technical skill. These findings highlight the need to incorporate AI literacy in a curriculum of higher education to

improve levels of cognitive engagement, academic success, and readiness of higher education students to address professional challenges in the future.

7. Discussion

The present study aimed to explore the relationship between Artificial Intelligence (AI) literacy and the critical thinking and problem-solving skills of students in higher education. The findings revealed that students demonstrated a relatively high level of AI literacy, indicating that they frequently engage with generative AI tools, digital research assistants, and intelligent learning platforms in their academic activities. This finding is consistent with the work of Long and Magerko (2020), who conceptualized AI literacy as a multidimensional competency involving technical knowledge, practical skills, and ethical awareness. The results suggest that higher education students are becoming increasingly familiar with AI technologies and are developing the ability to evaluate and utilize AI-generated information critically.

The study found a very strong positive relationship between AI literacy and critical thinking skills ($r = .998$, $p < .001$). This finding supports previous literature suggesting that AI literacy encourages learners to engage with information in a reflective and analytical manner rather than accepting AI-generated outputs without evaluation (Kong et al., 2021). The result is also consistent with Ng et al. (2021), who reported that students with higher levels of AI literacy demonstrate stronger judgment, analytical reasoning, and digital awareness. Furthermore, Holmes et al. (2019) argued that AI-supported learning environments can promote critical thinking by encouraging learners to question assumptions, evaluate sources, and consider multiple perspectives. The current findings strengthen this argument by providing empirical evidence that AI literacy contributes significantly to students' ability to analyze information critically and make informed academic decisions.

Similarly, the findings revealed a strong positive relationship between AI literacy and problem-solving skills ($r = .938$, $p < .001$). This result aligns with the theoretical perspective of Jonassen (2011), who described problem-solving as a process involving problem identification, analysis, and solution generation. Students with higher AI literacy appeared better able to utilize AI tools for information gathering, evaluating alternatives, and refining solutions through iterative learning processes. The findings also support Spector's (2014) assertion that technology-enhanced learning environments can strengthen problem-solving skills through adaptive feedback and dynamic learning experiences. The results indicate that AI-literate students can effectively leverage AI technologies to approach academic challenges in a systematic and strategic manner.

Another important finding was the strong positive relationship between critical thinking and problem-solving skills ($r = .937$, $p < .001$). This finding is supported by existing literature, which suggests that effective problem-solving depends heavily on critical thinking processes such as analysis, evaluation, inference, and logical reasoning (Facione, 2015). Students who demonstrated stronger critical thinking abilities were also more effective in identifying problems, evaluating possible solutions, and making sound decisions. This result confirms that critical thinking and problem-solving are closely interconnected cognitive competencies that reinforce one another, particularly in technology-rich learning environments.

The regression analysis further demonstrated that critical thinking and problem-solving skills jointly explained 99.5% of the variance in AI literacy ($R = .995$, $p < .001$). Among the two predictors, critical thinking emerged as the strongest predictor of AI literacy. This finding highlights that AI literacy extends beyond technical competence and is strongly associated with higher-order cognitive processes. The result supports the multidimensional perspective of AI

literacy proposed by Long and Magerko (2020), which emphasizes not only technical understanding but also critical evaluation and ethical reasoning. Students who possess stronger critical thinking abilities are likely better equipped to assess the reliability, validity, and limitations of AI-generated information, thereby demonstrating greater AI literacy.

The one-sample t-test results indicated that students scored significantly higher than the test value on AI literacy, critical thinking, and problem-solving skills. These findings suggest that students are actively engaged with AI technologies and possess a relatively strong foundation of cognitive skills. Such outcomes reflect the increasing integration of AI technologies into higher education and support recent educational trends emphasizing digital competence and technology-enhanced learning. The findings also suggest that AI tools, when used appropriately, may contribute to cognitive engagement and academic development.

Overall, the findings of this study support the growing body of literature highlighting the educational value of AI literacy. The results confirm that AI literacy is positively associated with critical thinking and problem-solving skills and can serve as an important contributor to students' cognitive development. These findings fill an important gap in the literature identified by previous scholars (Long & Magerko, 2020; Holmes et al., 2021), who noted the limited empirical evidence regarding the relationship between AI literacy and higher-order cognitive skills in higher education. The study therefore provides valuable evidence that AI literacy should be viewed not merely as a technical competency but as a cognitive and educational construct that promotes analytical reasoning, reflective learning, and effective problem-solving.

8. Conclusion

1. The study was to reveal whether there was a relationship between AI literacy and higher and order cognitive skills among university students who primarily dealt with critical thinking, problem, solving skills and general cognitive engagement. In accordance with the high application of the artificial intelligence in higher education, the study was aimed at evidence, facts-based on the impact of AI literacy on the formation of academic skills in students. Through quantitative methods and data collected with 300 students at university, the research has been able to reveal the enormous place of AI literacy in the contemporary learning environment.
2. The study has found that there is a high correlation between AI literacy and critical thinking skills amongst students in the university. Students who used AI tools more frequently were found to possess a high level of critical thinking skills. Perhaps, the use of AI tools by students in the course of their studies allows them to learn how to be critically evaluated, reflective, and analytical thinkers. In reference to findings, AI literacy cannot be considered as a technical skill but more as a cognitive skill which facilitates more profound learning processes.
3. The study also concludes that AI literacy positively influences the process of developing academic problem and solving skills in students. The strong relationship clearly indicated that students with intense use of AI tools were the same learners who had stronger problem, solving skills. Despite the fact that the research design is cross and hence cannot be applied in the causal inferences, the findings provide a good indication, which depicts that the two constructs, AI literacy and problem, solving skills, are directly related in this case, higher education.
4. Besides, the study touched upon the extent to which the general AI literacy decreases the cognitive engagement of students and the development of their skills. As it turned out, students achieved very high scores of AI literacy, critical thinking, and problem, solving

skills, and the high effect sizes were observed. The findings thus point to the idea that in as far as AI literacy is modeled as one overall construct it positively relates to the cognitive engagement of students and the acquisition of higher and order academic abilities. This is consonant to the fact that a productive application of AI would require an active involvement of the mind, as opposed to a passive use of technological outputs.

5. In general, the study can be characterized as the bridge between the existing theoretical framework and the current body of research as it empirically proves that the issue of AI literacy is deeply interconnected with the cognitive skills development. With AI literacy being discussed as a unified capacity that is automatically implied in the learning processes, the implication of digital literacy in higher education is deeper than previously. The results of the mentioned study are a clarion call to remember that AI literacy is to be taken into consideration as among the most basic academic skills that open the way to the intellectual development of students and equip them with the future academic and professional challenges.
6. These recognitions are accompanied by the limitations investigating the input of the research. Admittedly, the study was founded on data that were self, reported, and the cross, sectional research design used constrains the possibility of making causal inferences. In addition, the one-unit, single AI literacy constrained the study of specific AI, the associated skills.
7. These constraints are the ones that lead to the next generation of studies that will be longitudinal and objective in assessment methods and multidimensional AI literacy frameworks to build on the results of the present study.
8. The study fundamentally identifies the significance of the ability of the university students to be literate in Artificial Intelligence (AI) so as to be able to think critically, solve problems, and to engage their minds. With the consideration of the fact that AI continues to transform education delivery, the need to develop AI literacy via curriculum design, teaching methods and institutional policy is increasing.
9. The current study is more of a rallying call to teachers, researchers and policy makers in an attempt of promoting the use of AI, which is informed, reflective and cognitively involved resulting in influential learning outcomes in the dynamic digital landscape.

9. Recommendations

1. The problem of limitations that were identified has been tabulated in relation to the improvement proposals. It is implied that the latter studies must account for the possibility of utilizing longitudinal or experimental research design to confirm the causal associations and have the ability to track the changes in AI literacy and cognitive skills as time goes on. The objective performance which is based measures, such as task, based evaluations or AI, supported problem, solving activities should also be added to present a more accurate picture of the real competencies of students.
2. Moreover, the research team may take AI literacy as a multidimensional construct, which involves the investigation of the independent and integrated impact of the cognitive, technical, and ethical dimensions on the critical thinking and problem, solving skills. Mixed, method designs, i.e., the use of qualitative interviews or classroom observations, could also give more information in the ways of how students engage with AI in actual learning situations.
3. On the practical side of the matter, universities and colleges should be on the alert of the demands of the faculty in terms of training and curriculum redesign as an approach towards the ensuring of the successful and ethical utilization of the AI tools. Facilitation of the cognitive skills development can occur by the implementation of well and structured AI

literacy programs, which are aimed at the critical evaluation, bias awareness, and responsible use. Moreover, the government ought to establish the AI literacy model that will not only avail technology to all but also establish learning opportunities that are equitable. Combined, these actions will be in a position to increase the quality, relevance, and impact of future research and practice in AI, driven education.

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