Perceptions of Gifted and Talented Students Towards the Integration of AI Applications in Computer Science Learning

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DOI: https://doi.org/10.47772/IJRISS.2026.1026EDU0446

Received: 04 July 2026; Accepted: 09 July 2026; Published: 22 July 2026

ABSTRACT

This cross-sectional study explores the perceptions and interactions of gifted students regarding Artificial Intelligence (AI) applications in learning. Through purposive sampling, 60 students from Kolej PERMATA@Pintar Negara, UKM were involved to evaluate their level of understanding, practical skills, and the relationship between the two. The analysis revealed that the students' understanding of AI is high ($M = 3.88$), while their practical skills are at a moderate level ($M = 3.42$). A Pearson Correlation analysis indicated a significant positive relationship between AI knowledge and application skills ($r = 0.391$, $p < 0.05$). Additionally, ANOVA testing confirmed a significant difference in AI application skills based on the students' programming proficiency levels. In conclusion, a balanced educational ecosystem is crucial to optimize AI innovation while maintaining academic integrity and the well-being of gifted students.

Keywords: Artificial Intelligence (AI), Gifted Students, AI Integration, Computer Science, Academic Integrity.

INTRODUCTION

The 21st-century digital revolution has positioned Artificial Intelligence (AI) technology as a primary catalyst for transformation across various sectors, with the educational ecosystem receiving the most significant impact of these changes. The integration of AI technology, particularly the emergence of Large Language Models (LLMs) such as ChatGPT, has created an innovative paradigm shift in the teaching and learning landscape. In line with this scenario, a study by Mohamad Yatim et al. (2025) asserts that AI applications offer vast potential to enhance the quality of the education system, although at the same time, they invite ethical challenges and moral concerns that demand strict regulatory mechanisms. At the level of higher education institutions and technical universities, AI is beginning to be recognized as an efficient facilitating instrument to help students face the demands of academic assignments that require complex information processing capabilities (Daud et al., 2024; Mohamad Aliff Aiman Mohd Zawawi & Anim Zalina Azizan, 2024).

In the discipline of Computer Science, the demand to master skills in interacting with AI has now become an urgent necessity to ensure graduates remain relevant to the market and current technological evolution. However, the group of gifted and talented students requires a different observation lens and pedagogical approach, given that they possess unique cognitive capacities and socio-emotional profiles. According to Tengku Muda and Muhamad Saleh (2024), gifted and talented groups often face distinct socio-emotional stress issues, which have the potential to influence their patterns of acceptance and adaptation to any form of technological intervention. Therefore, in-depth scientific research into the level of understanding and usage strategies of AI among this demographic is critical. This aims to ensure that the surge in their intellectual potential can be nurtured in balance with the maintenance of mental health and the cultivation of scholarly ethical values (Sabran, Salleh & Ahmad, 2025).

Despite AI's ability to drive productivity, threats to academic integrity now dominate scholarly debates internationally. The risks of information manipulation, the proliferation of digital cheating practices, and

concerns about plagiarism force educational institutions to re-evaluate their conventional assessment instruments (Cotton, Cotton & Shipway, 2024; Perkins, 2023). Sullivan, Kelly, and McLaughlan (2023) have highlighted the importance of achieving a point of balance between the adaptation of smart technology and the preservation of academic quality standards. Furthermore, educational management leadership based on moral principles is also recommended to shape a sense of responsibility among students (Journal of University Teaching and Learning Practice, 2023).

In the Malaysian context, although research discourse related to AI is increasingly active, a research gap remains prominent when it involves the specific group of "gifted and talented students" within the "Computer Science" spectrum (Taha & Ajmain, 2025). Stemming from this gap, this quantitative survey study was initiated to explore their level of understanding, skill competence, and knowledge literacy regarding the integration of AI technology. The empirical data generated through this instrument is believed to be capable of providing a vital reference for policymakers and educators to design a sustainable holistic learning framework to face an AI-driven future.

LITERATURE REVIEW

AI Transformation in Higher Education

The presence of AI through the evolution of Large Language Model (LLM) algorithms such as ChatGPT has radically changed the higher education landscape. This paradigm shift was demonstrated through the analysis by Mohamad Yatim et al. (2025), who found that the landscape of knowledge transfer has begun to shift directions due to the interactive functions offered by AI platforms. Recent findings by local scholars such as Sabran, Salleh, and Ahmad (2025) strongly support this, recording an increase in the percentage of overall acceptance and integration of AI applications within the educational system.

AI as a Computer Science Learning Facilitator

Computer Science learning demands the mastery of high-level analytical capacities due to its structure, which is dense with algorithms and coding logic. This difficulty can be approached more proactively through the exploitation of AI software. The majority of students in technical institutions position ChatGPT as a dominant support agent capable of accelerating the translation of ideas and project completion (Daud et al., 2024; Mohamad Aliff Aiman Mohd Zawawi & Anim Zalina Azizan, 2024). This processing capacity elevates AI not merely as a search engine, but rather as a responsive tutorial platform.

Unique Needs of Gifted and Talented Students

One of the prominent characteristics of high-achieving students is an information processing speed that far exceeds their biological age. However, this advantage comes with psychological vulnerabilities; they are reported to become bored more easily, have extreme perfectionist tendencies, and are susceptible to emotional distress if they fail to obtain sufficient mental stimulation (Tengku Muda & Muhamad Saleh, 2024). The integration of AI is seen as having the potential to bridge this gap in cognitive needs by acting as a flexible personal facilitator tailored to the extraordinary thinking speed of this group.

Ethical Issues and Academic Integrity in the AI Era

The expansion of information technology has triggered a crisis regarding the security of copyright recognition in writing. Universities face difficulties in democratizing and drawing clear boundaries between blatant plagiarism and the transparent synthesis of machine-generated information. Cotton et al. (2024) termed this polemic "chatting and cheating," which is believed to have the potential to undermine the inherent value of academic certificates in the future if not addressed at the grassroots level. Recommendations to overhaul assessment methodologies away from traditional exam-oriented approaches are supported by several parties (Perkins, 2023; Sullivan et al., 2023) as a preparatory step for the post-pandemic era.

Research Gap

Based on the synthesis of previous studies, although there is an abundance of empirical research exploring AI applications in general along with the ethical implications that burden them, there is a literature gap concerning the focus on samples with extraordinary cognitive performance. Cross-sectional studies centered on the interaction and impact of AI technology on the profile of "gifted and talented students" within the "Computer Science" domain have not been widely conducted in Malaysia. Therefore, a clear need has emerged to implement such research initiatives, so that the resulting data can quantitatively explain their profile of understanding, skill levels, and the correlation of their foundational knowledge when handling these Generative AI instruments.

Research Objectives, Questions & Hypotheses

Research Objectives

This quantitative study was conducted to achieve the following four main objectives:

1. To identify the level of understanding of gifted and talented students regarding the integration of Artificial Intelligence (AI) applications in Computer Science learning.

2. To identify the skill level of gifted and talented students in operating AI applications, including the skill of filtering information to preserve academic integrity.

3. To determine the significant relationship between the level of knowledge about AI and the level of its application skills among gifted and talented students.

4. To identify significant differences in the level of AI application skills based on the programming proficiency level of gifted and talented students

Research Questions

Based on the outlined objectives, this study will answer the following questions through the analysis of empirical data:

1. What is the level of understanding among gifted and talented students regarding the integration of AI applications as facilitating tools in Computer Science learning?

2. What is the level of skills mastered by gifted and talented students when using AI innovations in completing academic assignments?

3. Is there a significant relationship between the level of knowledge of gifted and talented students regarding AI and their level of application skills?

4. Is there a significant difference in the level of AI application skills based on the level of computer programming proficiency among gifted and talented students?

Research Hypotheses

Guided by objectives 3 & 4, which are inferential tests, the research hypotheses are as follows:

1. **H_{01}:** There is no significant relationship between the level of knowledge of gifted and talented students regarding AI and their level of application skills.

2. **H_{a1}:** There is a significant relationship between the level of knowledge of gifted and talented students regarding AI and their level of application skills in Computer Science learning.

3. **H_{02}:** There is no significant difference in the level of AI application skills based on the students' computer programming proficiency.

4. **H_{a2}:** There is a significant difference in the level of AI application skills based on the students' computer programming proficiency.

METHODOLOGY

Research Design and Sample Selection

This study utilizes a quantitative approach with a cross-sectional survey design. The target population framework focuses on the community of gifted and talented students taking the Computer Science subject at Kolej PERMATA@Pintar Negara, Universiti Kebangsaan Malaysia (UKM). To meet the targeted demographic criteria, this study utilizes purposive sampling techniques to ensure the instrument is answered by respondents who genuinely interact with computer coding and AI. A total of 60 respondents were selected for this study.

Research Instrument

Primary data collection was conducted online using the Google Forms platform. The questionnaire was constructed through the adaptation of literature reviews and divided into four main sections: Section A records the demographic profile, while Sections B, C, and D are designed to measure the study variables, namely understanding, skills, and mastery of AI knowledge, respectively. The assessment of the instrument's responses relies entirely on a 5-point Likert Scale agreement instrument.

Pilot Study and Data Analysis

To evaluate the accuracy and language validity of the questionnaire items, a pilot test involving a 10% projection of the actual sample size was conducted in accordance with standard research procedures (Connelly, 2008). The results of the reliability test analysis recorded a Cronbach's Alpha coefficient value of 0.829, thus proving that the instrument has excellent internal consistency and is valid for full-scale field testing.

The collected quantitative data was then analyzed using SPSS (Statistical Package for the Social Sciences) software. Descriptive analysis was used to summarize frequencies, means, and standard deviations to answer objectives one and two. Inferential statistical analysis was applied using the Pearson Correlation Test for the $\boldsymbol{H_{01}}$ and $\boldsymbol{H_{a1}}$. While the One-Way ANOVA Test was used to answer the $\boldsymbol{H_{02}}$ and $\boldsymbol{H_{a2}}$. The significance level was set at $p < 0.05$.

FINDINGS

Demographic Profile of Respondents

Based on Table 1, the overall demographic profile of the study sample ($N = 60$) was analyzed as a basis for understanding the research context. In terms of gender distribution, the sample was dominated by male respondents, totaling 34 individuals (56.7%), compared to 26 female respondents (43.3%). An examination of the age composition indicates that the majority of the participants were students in their middle phase of secondary school. The 15 to 16 years old age group recorded the highest percentage with 29 individuals (48.3%), followed by the 13 to 14 years old age group with 16 individuals (26.7%). The remainder of the sample was completed by the 17 to 18 years old age group, which recorded an involvement of 15 respondents (25.0%).

From the perspective of digital interaction, the average frequency of operating Artificial Intelligence (AI) platforms showed that the majority of respondents (36 individuals; 60.0%) spent a moderate amount of time, around 1 to 3 hours a week. Usage of less than 1 hour and 4 to 5 hours each recorded 11 individuals (18.3%), while only 2 individuals (3.3%) used it for more than 6 hours a week. Regarding their level of practical expertise in writing programming codes, a large portion of the students (36 individuals; 60.0%) rated themselves at a

"Moderate" competency level, followed by 18 individuals (30.0%) at the "Proficient" level. Only a small number were at the extreme ends, namely "Basic" and "Highly Proficient", with 3 individuals (5.0%) respectively, thus indicating that this sample possesses the relevant basic skills for the purpose of this study.

Table 1. Demographic Distribution Profile of Respondents (*N*=60)

Demographic Category	Frequency (*f*)	Percentage (%)
Gender		
Male	34	56.7
Female	26	43.3
Age		
13-14 Years Old	16	26.7
15-16 Years Old	29	48.3
17-18 Years Old	15	25.0
Frequency of AI Usage Per Week		
Less than 1 Hour	11	18.3
1-3 Hours	36	60.0
4-5 Hours	11	18.3
More than 6 Hours	2	3.3
Programming Proficiency Level		
Basic	3	5.0
Moderate	36	60.0
Proficient	18	30.0
Highly Proficient	3	5.0

Note. Collected demographic data for the entire sample size (*N*=60).

Analysis of the Level of Understanding of AI Integration

The findings in Table 2 confirm strong support regarding the deep understanding competency recorded by the respondents. The overall average recorded findings at a high-level score. The most consistent agreement centered on the statement "I realize that AI can generate programming code quickly, but it still requires human logical review," which recorded a value of $M = 4.62$ ($SD = 0.640$).

Table 2. Descriptive Analysis: Level of Understanding (*N*=60)

Understanding Item	Mean (*M*)	Standard Deviation (*SD*)
I clearly understand how AI applications function as assistants in Computer Science learning.	4.40	0.741
I realize that AI can generate programming code quickly, but it still requires human logical review.	4.62	0.640
I am confused about distinguishing between accurate solutions and fabricated information ("hallucinations") generated by AI.	3.00	1.164
I understand that AI is merely a support tool, not a substitute for my analytical thinking.	4.57	0.621

It is difficult for me to understand the algorithmic process or logic behind the suggested answers provided by AI.	2.92	1.197
I know the limits of AI's capabilities, such as its inability to resolve highly complex system errors (system bugs) without specific input.	4.23	0.698
I assume that all information or programming code generated by AI is 100% accurate and can be used immediately.	3.45	1.320

Note. The mean score is measured based on a 5-point Likert Scale agreement.

Analysis of the Level of Practical AI Usage Skills

The overall analysis findings conclude that the status of AI software navigation ability within the Computer Science practical arena places the respondents at a "Moderate" Level (Table 3). Although the students claim to be skilled in structuring specific programming command lines (prompt engineering) ($M = 3.73$, $SD = 0.936$), the findings reveal a psycho-emotional concern when they face the possibility of the software's absence. On average, respondents expressed a sense of helplessness and extreme anxiety if project assignments were given without access to AI platform support facilities ($M = 2.98$).

Table 3. Descriptive Analysis: Level of AI Skills (*N*=60)

Understanding Item	Mean (*M*)	Standard Deviation (*SD*)
I am skilled at writing specific instructions (prompt engineering) to get accurate coding answers from AI.	3.73	0.936
I often copy-paste programming code from AI without making any modifications.	3.33	1.244
I am capable of reviewing, testing, and debugging programming code suggested by AI.	3.70	0.979
I feel anxious, stuck, and stressed when having to complete Computer Science projects without the help of AI platforms.	2.98	1.186
I use AI strategically for brainstorming sessions to structure my system architecture in the early stages.	3.58	1.154
It takes me too long to get the answer I want from AI because I don't know how to ask the right questions.	3.00	1.179
I am skilled at combining my own programming logic with AI-generated code snippets to build a complete program.	3.63	1.089

Note. The mean score is measured based on a 5-point Likert Scale agreement.

Level of Knowledge Regarding AI

Based on Table 4, the domains of technical and ethical knowledge, educational institution guidelines, and cybersecurity breach risks demonstrated very strong support. Overall, gifted and talented students demonstrated a deep understanding of the limits of academic integrity; that the act of submitting assignments entirely generated by AI engines is a violation of academic ethics ($M = 4.57$, $SD = 0.810$).

Table 4. Descriptive Analysis: Level of Technical & Ethical Knowledge (*N*=60)

Understanding Item	Mean (*M*)	Standard Deviation (*SD*)
I know how to distinguish the boundary between using AI as an academic reference and the act of plagiarism.	4.22	0.761
I am unsure about my institution's academic integrity guidelines regarding the limits of AI usage in assignments.	3.22	1.151
I am aware that personal data or code I input into public AI can be at risk in terms of confidentiality and privacy.	4.42	0.696
I do not care about the possible existence of biased elements in the algorithmic code generated by AI.	3.52	1.157
I know the procedures for giving proper acknowledgment (APA citation/reference) when using AI-generated text in project reports.	3.57	0.945
I understand that submitting an assignment that is 100% generated by AI is a violation of academic ethics.	4.57	0.810
I believe that the work generated by AI becomes fully my property and is not subject to copyright issues.	3.00	1.262

Note. The measurement focuses on academic literacy knowledge and AI data security.

Correlation Analysis of the Relationship: Knowledge and Skills

In this inferential analysis phase, the application of the Pearson Correlation statistical matrix function was utilized extensively to explore the pattern of the relationship between the students' capacity for AI computing literacy knowledge and their standard level of practical manipulation skills when interacting with the system. Specifically, this analysis focuses on evaluating how theoretical understanding, which encompasses awareness of AI limitations, academic integrity guidelines, and data security risks that translates into practical mastery, such as the formulation of optimal prompt techniques (prompt engineering) and code debugging.

The Pearson Correlation coefficient (r) was selected as the most appropriate statistical instrument because it effectively measures both the strength and the direction of the linear relationship between these two continuous variables. By cross-examining the accumulated mean scores for AI knowledge against the mean scores for practical AI skills among the 60 gifted and talented respondents, this test aims to empirically validate whether an increase in cognitive understanding of AI ecosystems corresponds with a higher proficiency in utilizing these digital tools for Computer Science tasks. The outcomes of this bivariate analysis are crucial for answering the third research question and determining the eventual rejection or acceptance of the formulated null hypothesis ($\boldsymbol{H_{01}}$). Based on the analysis, the significant p-value ($p < 0.05$) indicates that the null hypothesis ($\boldsymbol{H_{01}}$) is firmly

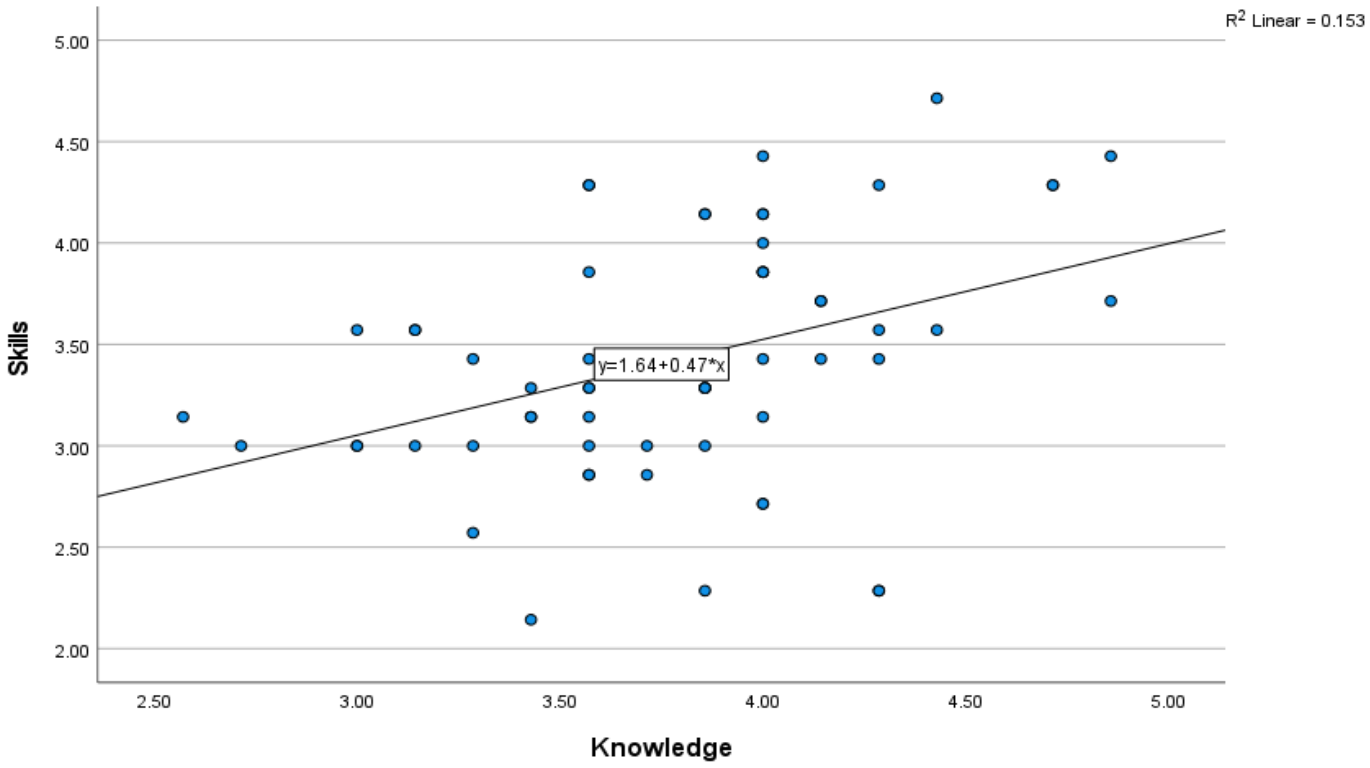
rejected. Consequently, the alternative hypothesis (H_{a1}) is accepted, confirming that a higher cognitive understanding of AI ecosystems significantly correlates with greater practical application skills among the students.

Table 5. Results of the Pearson Correlation Test Analysis (*r*)

Variables	Knowledge Mean	Skills Mean
Knowledge Mean		
Pearson Correlation	1	.391**
Sig. (2-tailed)		.002
N	60	60
Skills Mean		
Pearson Correlation	.391**	1
Sig. (2-tailed)	.002	
N	60	60

Note. Correlation is significant at the 0.01 level (2-tailed)

Figure 1. Scatter Plot Illustrating the Correlation Between AI Knowledge and Application Skills



Note. The scatter plot demonstrates a significant positive linear relationship ($r = 0.391$, $p < 0.05$) between the students' level of AI knowledge and their practical application skills ($N = 60$).

Differences in Skills Based on Programming Proficiency (ANOVA)

To detail the demographic profile pattern, a second inferential statistical test, namely the One-Way ANOVA, was applied in detail to unravel the variance in AI skill levels across the hierarchical groups of practical computer coding language mastery, namely Basic, Moderate, Proficient, and Highly Proficient.

Table 6. Descriptive Statistics for Skills Mean Based on Programming Proficiency Level

Group	*N*	Mean (*M*)	Standard Deviation (*SD*)
Basic	3	2.52	0.540
Moderate	36	3.21	0.428
Proficient	18	3.96	0.453
Highly Proficient	3	3.61	0.733
Total	**60**	**3.42**	**0.598**

Note. Details of the mean and standard deviation values for skills.

Table 7. One-Way ANOVA Analysis of AI Skills Based on Programming Proficiency

Group	Sum of Squares	*df*	Mean Square	*F*	*Sig.*
Between Groups	9.521	3	3.174	15.347	<.001
Within Groups	11.580	56	0.207		
Total	21.101	59			

Note. The findings confirm significant differences across the four different levels of computer proficiency.

Based on the presentation of Table 7, the analysis results reveal that the F-test recorded a value of $F(3, 56) = 15.347$ with a significance level of $p < 0.001$. This indicator, being lower than the standard alpha error (0.05), confirms that the test findings are highly significant, thereby strengthening the empirical conclusion to completely reject the null hypothesis ($\boldsymbol{H_{02}}$).

To investigate the source of these differences, the Post-Hoc Tukey HSD analysis found that the AI skills of the Proficient group are significantly higher compared to the Basic students (mean difference = 1.44, $p < .001$) and Moderate students (mean difference = 0.75, $p < .001$). The Highly Proficient group also showed a significant mean difference in AI skills when compared to the Basic group ($p = 0.023$). These statistical findings shed light on the understanding that algorithmic literacy is a solid prerequisite for fluency in crafting commands (prompting) for valuable AI response generation.

DISCUSSION

Overall, the research findings prove that gifted and talented students possess high analytical intelligence, especially in filtering information from Generative AI applications. This aligns with recent observations that students with stronger foundational knowledge are significantly better equipped to critically evaluate machine-

generated outputs, as generative models inherently lack true semantic understanding and often generate plausible but incorrect responses (Baidoo-Anu & Owusu Ansah, 2023). They are clearly able to distinguish between rational facts and fabricated information (AI hallucinations). This group also understands that AI is merely a support tool that requires final human review before its output can be utilized. Such critical digital literacy is increasingly essential today, as relying blindly on large language models without domain expertise can lead to the compounding of algorithmic errors and structural biases (Ray, 2023). Furthermore, this dynamic interaction perfectly aligns with the emerging educational paradigm where AI acts as a collaborative cognitive partner, actively pushing high-achieving learners to engage in deeper problem-solving rather than just passively consuming automated answers (Ouyang & Jiao, 2021). These findings support previous research by Tengku Muda and Muhamad Saleh (2024) regarding the cognitive thinking characteristics of gifted and talented students.

However, from an emotional perspective, students exhibit anxiety and a loss of motivation to learn if access to AI is restricted. This dependency syndrome (FOMO) and the inability to process information without algorithmic assistance confirm the concerns of global scholars regarding the negative effects of excessive digital technology interventions in schools. Current literature highlights that an over-reliance on generative AI can diminish students' intrinsic motivation, leading to "cognitive offloading" where learners become heavily dependent on the technology to initiate or sustain complex cognitive tasks (Lo, 2023). Furthermore, the ANOVA test analysis proves that a student's level of programming (coding) proficiency significantly influences their efficiency in constructing effective commands (prompt engineering) while exploring the Computer Science subject. This phenomenon is corroborated by Dwivedi et al. (2023), who emphasize that sophisticated prompt engineering is not merely a basic linguistic skill, but a complex competency deeply tied to the user's substantive mastery of the subject matter being queried.

IMPLICATIONS AND RECOMMENDATIONS

The findings of this study demand several follow-up actions from various stakeholders. At the institutional management level, guidelines and a code of ethics for AI usage must be established immediately. Rather than implementing restrictive bans that hinder technological literacy, institutions must develop proactive pedagogical frameworks that seamlessly integrate AI into the curriculum while defining clear boundaries for its ethical use (Kasneci et al., 2023). This policy should define the permissible limits of AI usage in assignments and mandate transparent cross-checking practices.

As for Computer Science instructors, they ought to act as human validators. Lecturers are advised to assess workflows such as pseudo-code logic rather than focusing solely on the final output, in order to curb "cheating and chatting" activities during the early stages of writing. By shifting the evaluation paradigm from the final product to the process of creation, educators can better gauge authentic learning and foster a deeper understanding of computational logic (Swiecki et al., 2022).

To preserve the emotional well-being of this high-performing student group, the counseling unit must play an active role in monitoring any signs of cognitive stress or excessive digital dependency. Synergistically, "digital detox" programs are highly encouraged to help students balance technology usage with real-world social interaction. Cultivating this balance is imperative, as human-centric social interactions and pastoral care play a critical role in mitigating the psychological stress associated with the rapid influx of disruptive educational technologies (Su & Yang, 2023).

CONCLUSION

In conclusion, this study proves that Artificial Intelligence (AI) is a highly effective learning support system for gifted and talented students within the Computer Science ecosystem. Although a positive relationship exists between their level of understanding and practical skills when navigating these applications, academic integrity and emotional stability must remain the primary shields in shaping student character. Mastery of Computer Science will only yield meaningful results if skills in managing Generative AI systems are balanced with intellectual values and moral responsibility. Ultimately, the responsible and ethical integration of generative AI should serve as a steppingstone toward lifelong learning, empowering students to use technology as an extension

of human intellect rather than its absolute replacement (Mhlanga, 2023). It is this balance that will produce a future generation of innovation leaders who possess high resilience, without succumbing to absolute dependency on robotic capabilities.

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