International Journal of Education and Practice
2026 Vol. 14, No. 3, pp. 169-182
ISSN(e): 2310-3868
ISSN(p): 2311-6897
DOI: 10.18488/61.v14i3.5043

The impact of AI usage and AI literacy on students learning engagement and creativity of accounting students in Chinese higher vocational colleges

Liujing You[1]
Maryam Ikram[2+]
Shamsiah Banu Mohamad Hanefar[3]
Basit Ali[4]

[1,2,3]*Faculty of Education and Liberal Arts, INTI International University, Nilai, Negeri Sembilan, Malaysia.*
[1]*Email: I24029004@student.newinti.edu.my*
[2]*Email: maryam.ikram.um@gmail.com*
[3]*Email: shamsiah.mhanefar@newinti.edu.my*
[4]*ILMA University, Karachi, Pakistan.*
[4]*Email: basit.ali@ilmauniversity.edu.pk*

(+ Corresponding author)

Article History
Received: 25 August 2025
Revised: 27 February 2026
Accepted: 4 June 2026
Published: 16 July 2026

Keywords
AI literacy
Artificial intelligence
Creativity
Education quality
Learning engagement.

ABSTRACT

In the context of the rapid development of generative artificial intelligence, college students are increasingly applying AI platforms such as ChatGPT and DeepSeek to their learning practices, a behavior that has a profound impact on their learning methods and innovative abilities. However, there has been a lack of systematic exploration into the underlying mechanisms by which AI usage and AI literacy influence students' engagement and creativity. Therefore, this study aims to construct and validate a theoretical model with AI usage and AI literacy as independent variables and student engagement and creativity as dependent variables. The study employed a quantitative method, collecting 295 valid responses covering variables such as AI usage frequency, AI literacy levels, learning engagement, and creativity. Descriptive statistics, correlation analysis, and multiple regression analysis were conducted using SPSS. The results indicate that AI literacy has a significant positive impact on student engagement and creativity; AI usage enhances student engagement and interest; and AI usage and AI literacy focus more on stimulating thinking rather than producing works when enhancing creativity, which has important implications for educational assessment outcomes. This study not only enriches the theoretical framework of educational technology in the context of artificial intelligence but also provides practical references for universities in promoting AI literacy education and cultivating student creativity. The originality of this work lies in bridging the gap between AI adoption research and vocational education practice, offering context-specific insights that can guide curriculum reform and policy initiatives in China.

Contribution/Originality: This study contributes to the existing literature by empirically examining the joint effects of AI usage and AI literacy on engagement and creativity among accounting students in Chinese vocational colleges. It is one of the few studies investigating AI adoption within a discipline-specific vocational education context.

1. INTRODUCTION

In recent years, AI technologies such as intelligent tutoring systems, personalized learning platforms, and AI-driven interface design have been widely adopted in higher vocational education, enhancing student engagement, motivation, and learning experiences. AI literacy the ability to understand, use, and evaluate AI in learning contexts has become a crucial competence for students in the digital era (Cai, 2022; Kim, Suh, Heo, & Choi, 2020; Ng, Xinyu, Leung, & Chu, 2024).

Globally, AI-enabled tools, including smart tutoring and automated feedback are transforming traditional education in alignment with UN Sustainable Development Goal 4 (SDG 4), which promotes inclusive and equitable quality education. LLMs such as DeepSeek are increasingly piloted in Chinese higher education, including initiatives reported in Guangdong province, though large-scale adoption remains emerging (Guangdong Education Department, 2025; Ministry of Education of the People's Republic of China, 2025). However, the impact of AI relies on both usage frequency and literacy, and empirical studies in vocational accounting education remain limited. Challenges such as outdated infrastructure and unbalanced curriculum design further restrict AI's effectiveness, widening the digital divide (Eulerich, Sanatizadeh, Vakilzadeh, & Wood, 2024; Fang, Abdallah, & Vorfolomeyeva, 2024; Ma, 2025).

Despite rapid AI development, China's vocational education lags in content and models. Effective AI use in learning and innovation depends heavily on students' usage behavior and literacy, yet related empirical research is scarce. Infrastructure gaps, outdated curricula, and unequal resources hinder the realisation of SDG 4 (Blahopoulou & Ortiz-Bonnin, 2025; Chen, 2024; Jiang, Liu, Geng, & Fu, 2025; Lan & Zhou, 2025). Unlike most prior studies that examine general higher education, this study focuses specifically on accounting students in Chinese vocational colleges, a group for whom engagement and creativity are critical for professional competence. By analyzing how AI usage and AI literacy jointly affect these outcomes, the study extends prior work by linking AI adoption to both cognitive and creative capacities in a vocational discipline.

The study specifically aims to examine the relationship between AI usage and student engagement, examine the relationship between AI usage and student creativity, assess the relationship between AI literacy and engagement, assess the link between AI literacy and creativity, and identify key predictive factors among these variables.

This research supports AI integration in vocational education, aligning with national digital education strategies and SDG 4 (Clark et al., 2025). Academically, it evaluates DeepSeek's application in Guangdong to inform curriculum development and teacher training (Zhang et al., 2025). For the industry, findings on AI literacy and creativity support school–enterprise cooperation and AI skill development (Chen, 2024). Socially, the study addresses risks of tech-driven inequality, advocating "Learning for All" (Albuhairy & Algaraady, 2025; Song et al., 2025).

2. LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

This study examines prior research on Artificial Intelligence Usage (AI usage), Artificial Intelligence Literacy (AI literacy), Student Engagement (SE), and Student Creativity (SC), focusing on their interrelationships in higher vocational education. The discussion is organized into four main sections: the relationship between AI usage and SE, AI usage and SC, AI literacy and SE, and AI literacy and SC. Relevant theories are introduced to explain the mechanisms linking these variables, leading to the development of the conceptual framework and research hypotheses.

2.1. AI Usage and Student Engagement

AI usage has been shown to enhance students' participation by providing personalized learning paths, instant feedback, and adaptive support. Prior studies suggest that AI-driven environments can increase behavioral engagement, such as participation in class activities and task completion, as well as emotional engagement through increased interest and satisfaction. However, the effect depends on both the stability of the platform and the integration into the curriculum.

In China's higher vocational institutions, while AI introduction has improved questioning frequency and submission rates, students' active exploration and cross-task transfer remain limited due to technological instability and insufficient guidance in higher-order learning (Hassan, Rahim, Hoong, & Mostafa, 2025). Hence, this study has formulated the following hypothesis:

H_1: There is a significant relationship between AI usage and student engagement.

2.2. AI Usage and Student Creativity

Creativity, defined as the capacity to produce original and meaningful solutions, is supported by AI tools that aid idea generation, refinement, and cross-domain association (Bećirović, Polz, & Tinkel, 2025; Black & Tomlinson, 2025). Research shows that frequent and deep interaction with AI is associated with higher creativity, especially in generating novel and practical outputs with ethical awareness (Shahzad, Xu, & Zahid, 2025). Nevertheless, in local higher vocational contexts, students often treat AI outputs as "standard answers" and lack the ability or willingness to reprocess, critique, or creatively adapt them, partly due to assessment systems favoring standardized responses and over-reliance on AI-generated content (Zhai, Wibowo, & Li, 2024). Hence, this study has formulated the following hypothesis.

H_2: There is a significant relationship between AI usage and students' Creativity.

2.3. AI Literacy and Student Engagement

Student engagement encompasses behavioral, emotional, and cognitive participation, with AI literacy playing a key role in enabling students to fully exploit AI tools for learning. Students with higher AI literacy understand AI logic, operate tools efficiently, and make ethical decisions, tending to show stronger self-directed learning and deeper cognitive engagement (Faraon, Rönkkö, Milrad, & Tsui, 2025; Jin et al., 2025; Zhao, 2024). Yet in many higher vocational institutions, AI literacy education is fragmented, relying on self-study or limited teacher guidance, and has not been systematically embedded into curricula, affecting overall effectiveness and student preparedness (Wang, Cui, & Yuan, 2025). This gap limits students' ability to integrate AI tools into active, reflective learning processes. Hence, this study has formulated the following hypothesis.

H_3: There is a significant relationship between Artificial Intelligence Literacy (AI literacy) and Students Engagement (SE).

2.4. AI Literacy and Student Creativity

AI literacy is also a critical factor in fostering creativity, as it enables students to critically evaluate AI outputs, integrate them with prior knowledge, and generate innovative solutions. Studies indicate that students with strong technological cognition, operational skills, and ethical judgment can better leverage AI for cross-domain association, reconstruction of ideas, and ethically grounded innovation (Ranta, Ylinen, & Järvenpää, 2023; Shahzad et al., 2025). In contrast, limited AI literacy often results in passive acceptance of AI-generated content, reducing opportunities for original thought and creative problem-solving. Hence, this study has formulated the following hypothesis.

H_4: There is a significant relationship between Artificial Intelligence Literacy (AI literacy) and Students' Creativity (SC).

2.5. Related Theories

To deeply analyze how AI use and literacy affect students' learning engagement and creativity performance, this study comprehensively introduces three types of classical educational and technological theories to build a theoretical support system and explain the mechanism paths between variables.

2.5.1. Student Engagement Theory

Some studies have proposed that students' learning engagement includes behavioral, emotional and cognitive dimensions: behavioral participation reflects students' explicit performance such as attendance and completion of homework in classroom activities; emotional participation reflects their interest in and sense of belonging to courses and learning situations; cognitive participation involves their learning strategies, critical thinking and deep learning tendencies (Wang et al., 2025). AI technology can stimulate students' multi-dimensional participation performance through mechanisms such as immediate feedback, personalized resources, and self-paced learning (Zhao, 2024). Therefore, this theory provides a structured analytical framework for explaining the relationship path of "AI use-student engagement" and "AI literature-student engagement."

2.5.2. Constructivist Learning Theory

Based on Vygotsky (1978) socio-culturally oriented constructivist view, learning is regarded as a process of knowledge construction supported by social interactions and tools (Kim, Kim, & Kim, 2025). AI platforms, as "cultural tools" and "cognitive scaffolds", can promote students' cognitive development through dialogic feedback (Güner & Er, 2025), multimodal input and collaborative task support. Especially in higher vocational education, AI can help students bridge the gap between their "zone of proximal development" and enterprise practice. Therefore, this theory provides an ontological foundation for understanding how AI can influence learning engagement and creativity through social contextual interventions.

2.5.3. Technology Acceptance Model (TAM/UTAUT)

This study draws on the Technology Acceptance Model (TAM) developed by Davis (1989), which identifies perceived usefulness and perceived ease of use as central determinants of technology adoption. To complement this perspective, we also reference the Unified Theory of Acceptance and Use of Technology (UTAUT) proposed by Venkatesh, Morris, Davis, and Davis (2003), which expands TAM by incorporating factors such as social influence and facilitating conditions. Together, these models provide a theoretical foundation for examining how AI usage and AI literacy influence students' engagement and creativity in vocational education settings.

As shown in Figure 1, the study's conceptual framework is built upon two primary independent variables (AI use, AI literacy) and two major dependent variables (student engagement, student creativity), which explicitly show the relationship between the pathways:

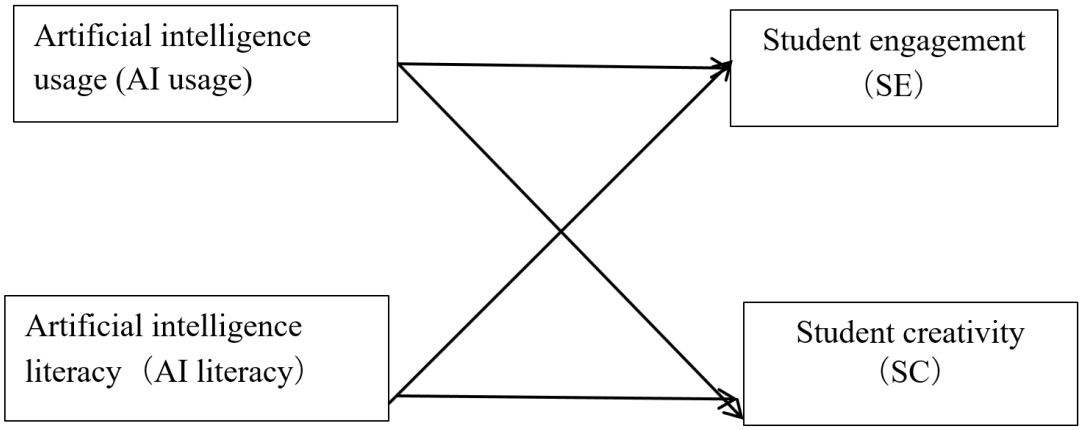

Figure 1. Conceptual framework of the study.

3. METHODOLOGY

This study adopts a positivist research paradigm, employing a quantitative method to examine the pathways through which Artificial Intelligence usage and AI literacy influence learning engagement and creativity among higher vocational accounting students (Maksimovic & Evtimov, 2023). Guided by a hypothesis-driven framework, the research collects measurable data on AI usage behavior, AI literacy, learning engagement, and creativity through questionnaires and analyses the data using SPSS for descriptive statistics, reliability assessment, Pearson correlation, and multiple regression (Rahman & Muktadir, 2021). Emphasis is placed on variable operationalization, scale design, and hypothesis testing to ensure data standardization and the scientific rigor of statistical inference, while maintaining researcher–participant distance to enhance the objectivity and generalizability of the findings.

3.1. Research Design, Population and Sampling

This study employed a cross-sectional design to examine associations between AI usage, AI literacy, learning engagement, and creativity. While this design identifies significant relationships, it does not establish causality.

Targeting accounting students from Shenzhen Polytechnic (n = 150) and Guangzhou Panyu Polytechnic (n = 145) in Guangdong (Liao, 2025), stratified sampling ensured gender and grade balance. A pilot test confirmed scale reliability. The final online survey (n = 295) measured four core variables and demographics. Data were analyzed using SPSS for descriptive statistics, reliability, correlation, and regression to test four hypothesized paths.

3.2. Instrumentation

This study used a structured questionnaire adapted from established literature to measure students' AI-related learning behaviors in China's vocational education. It included 24 five-point Likert items across five dimensions: AI Usage (Wang, Rau, & Yuan, 2023), AI Literacy (Lintner, 2024), Student Engagement (Evans & Zhu, 2023), Student Creativity (Yin, Han, Huang, Zuo, & Childs, 2021), and Negative Impacts of AI. Four demographic items were also included. Content validity was confirmed via expert review and a pilot test assessed clarity and reliability (Cronbach's α). SPSS was used for statistical analysis.

3.3. Statistical Analysis

This study employed rigorous statistical methods. Descriptive statistics summarized demographics and variable distributions. Reliability was confirmed using Cronbach's α, while Exploratory Factor Analysis (EFA) supported structural validity (KMO > 0.70, Bartlett's *p* < .001). Pearson correlation assessed associations between variables. Assumptions for regression analysis were tested: multicollinearity (VIF), residual normality (Kolmogorov–Smirnov/Shapiro–Wilk), and homoscedasticity (Breusch–Pagan). Multiple Linear Regression (MLR) tested four hypotheses with controls (gender, grade), reporting R^2, significance levels, and standardized coefficients to evaluate model fit and hypothesis support.

4. DATA ANALYSIS AND RESULTS

This chapter systematically analyzes the collected data to verify the proposed hypotheses and examine the relationships among AI usage behavior, AI literacy, student learning engagement, and creativity. The analysis follows the methods outlined in the methodology section and includes descriptive statistics, reliability testing, validity assessment, correlation testing, and multiple regression analysis.

Prior to formal analysis, data cleaning was conducted to ensure quality and consistency. Invalid questionnaires, those incomplete, with excessive missing values, abnormally short response times, or highly repetitive answers were removed. For a small number of randomly missing items, mean imputation was applied. Reverse-scored items were recoded to maintain scoring consistency, and outliers (Z > ±3) were excluded using standardized residuals. After cleaning, 295 valid responses were retained (Table 1).

Table 1. Descriptive statistics of the scale.

Survey item	N	Minimum	Maximum	Mean	Std. deviation	Variance
Your gender is:	295	1	2	1.58	0.49	0.24
Grade:	295	1	3	2.01	0.80	0.63
Have you received any AI-related courses or training?	295	1	2	1.39	0.48	0.23
How often do you use AI platforms (e.g., DeepSeek, ChatGPT, etc.) for learning each week?	295	1	4	2.62	0.88	0.78

Reliability analysis was performed using Cronbach's Alpha. The combined scale of 20 items yielded a Cronbach's Alpha coefficient of 0.928 (standardized α = 0.92), surpassing the 0.9 benchmark for excellent reliability, indicating strong internal consistency and measurement stability (Table 2).

Table 2. Reliability statistics of the scale.

Cronbach's alpha	Cronbach's alpha based on standardized items	N of items
0.928	0.92	20

Validity analysis included both content and structural validity. Exploratory factor analysis (EFA) was conducted using principal component analysis (PCA). Internal consistency was excellent (Cronbach's $\alpha = .928$). Exploratory factor analysis was conducted using principal axis factoring (PAF), appropriate for construct validation. Sampling adequacy was confirmed (KMO = 0.872), and Bartlett's test of sphericity was significant ($\chi^2 = 1532.48$, df = 276, $p < .001$). Summary item statistics showed item means clustered at a high level (M = 3.41, range = 3.30–3.50) with small variance (0.002) and average inter-item correlations of 0.39 (range = 0.18–0.74), reflecting good internal consistency (Table 3). Content validity was supported by Cochran's Q test results (Q = 14.92, Sig = .72 > 0.05), indicating no significant differences between items and strong consistency across dimensions (Table 4).

For scale validation, non-parametric procedures were used: Friedman's χ^2 test assessed differences in related-samples rankings, while Cochran's Q was applied for dichotomous items. This correction replaces the earlier inconsistent labeling.

Table 3. Summary item statistics of the scale.

Statistic	Mean	Minimum	Maximum	Range	Maximum / Minimum	Variance	N of items
Item means	3.41	3.30	3.50	0.20	1.06	0.002	20
Inter-item correlations	0.39	0.18	0.74	0.561	4.07	0.019	20

Table 4. ANOVA with Friedman's test of the scale.

Source of variance	Sum of squares	df	Mean square	Cochran's Q	Sig.
Between people	3123.01	294	10.62		
Between items	11.42	19	0.60	14.92	0.72
Residual	4277.13	5586	0.76		
Total	4288.55	5605	0.76		
Grand Total	7411.56	5899	1.25		
Grand Mean = 3.41					

Overall, the questionnaire demonstrated excellent reliability and validity, providing a solid foundation for subsequent descriptive, correlation, and regression analyses.

4.1. Demographic Profile

A total of 295 valid responses were collected from accounting students at two higher vocational colleges. Of these, 124 (42.0%) were male and 171 (58.0%) were female. Regarding academic year, 92 (31.2%) were first-year students, 107 (36.3%) were second-year students, and 96 (32.5%) were in their third year. In terms of AI-related education, 181 respondents (61.4%) reported having received formal AI courses or training, while 114 (38.6%) had not.

For AI usage frequency, 32 students (10.8%) reported never using AI platforms, 97 (32.9%) used them occasionally (1–2 times/week), 118 (40.0%) used them frequently (3–5 times/week), and 48 (16.3%) used them daily. Overall, the sample showed a relatively balanced gender distribution, a reasonable spread across grades, and diverse levels of AI exposure, providing a representative foundation for further analysis (Table 5).

Table 5. Demographic Profile of Respondents.

Demographic characteristics	Variables	Frequency (n)	Percent (%)
Gender	Male	124	42
	Female	171	58
Grade	Year 1	92	31.2
	Year 2	107	36.3
	Year 3	96	32.5
Have you received any AI-related courses or training?	Yes	181	61.4
	No	114	38.6
AI usage frequency	Never	32	10.8
	Occasionally (1–2 times/Week)	97	32.9
	Frequently (3–5 times/Week)	118	40
	Daily	48	16.3

4.2. Correlation Analysis

To explore the relationship between AI usage behavior, AI literacy, student learning engagement, and student creativity, the study employed Pearson correlation analysis for statistical testing, with results presented in Table 6.

The analysis results indicate a significant moderate positive correlation between AI usage behavior and student learning engagement ($r = .49$, $p < .01$), suggesting that the more frequently and actively students use AI tools during the learning process, the higher their level of learning engagement, including positive performance across multiple dimensions such as emotional, behavioral, and cognitive aspects. Similarly, there is a significant positive correlation between AI usage behavior and student creativity ($r = .44$, $p < .01$), indicating that active use of AI tools helps stimulate students' creative thinking and innovative performance.

In terms of AI literacy, the study found a significant moderate positive correlation with both student learning engagement ($r = .44$, $p < .01$) and student creativity ($r = .45$, $p < .01$). This suggests that students with higher levels of AI knowledge, skills, evaluation, and ethical awareness are more likely to demonstrate higher levels of engagement and creativity during the learning process.

Additionally, a significant positive correlation between student learning engagement and creativity ($r = .44$, $p < .01$) further confirms the synergistic effects between learning motivation, focus, and creative performance. Overall, AI-related competencies (including usage behavior and literacy) are significantly associated with learning outcomes, supporting the research hypothesis that the effective integration of AI can promote students' active exploration, deep engagement, and innovative expression.

4.2.1. Regression Diagnostics

Regression assumption checks included:

Normality: Shapiro–Wilk $p < .05$ indicated non-normality; robust methods were used.

Multicollinearity: VIF values ranged from 1.24 to 2.31, below the threshold of concern.

Homoscedasticity: Breusch–Pagan test $p = 0.31$ suggested equal variances.

Independence of errors: Durbin–Watson = 0.69 indicated substantial positive autocorrelation. This is noted as a limitation, and future studies could adopt clustered regression models (e.g., by institution).

Table 6. Correlations between AI usage, AI literacy, student engagement, and student creativity (N = 295).

Variables	1	2	3	4
1. AI usage	—			
2. AI literacy	0.48**	—		
3. Student engagement (SE)	0.49**	0.44**	—	
4. Student creativity (SC)	0.44**	0.45**	0.44**	—

Note: Pearson correlation coefficients are presented.
** $p < 0.01$ (two-tailed).

4.3. Multiple Regression Analysis

This section uses multiple linear regression analysis to test the validity of the four hypotheses (H_1–H_4) proposed in this study. Specifically, student engagement and creativity are used as dependent variables to explore the predictive effects of AI usage and AI literacy on them.

4.3.1. Multiple Regression Analysis of AI usage and AI Literacy on Student Engagement (H_1 and H_3)

A multiple linear regression was conducted to examine the predictive roles of AI usage and AI literacy on student engagement. The model (Table 7) showed R = 0.55, R^2 = 0.30, and adjusted R^2 = 0.29, indicating that the two predictors explain 30.4% of the variance. The Durbin–Watson value (0.69) suggests slight positive autocorrelation. ANOVA results (Table 8) confirmed the model's significance, F (2, 29) = 63.80, p < .001. Regression coefficients (Table 9) indicated that AI usage (B = 0.40, β = 0.37, p < .001) and AI literacy (B = 0.307, β = 0.26, p < .001) are both significant positive predictors, with AI usage having a slightly stronger effect. Tolerance (0.76) and VIF (1.30) values indicated no multicollinearity issues. Overall, both variables significantly predict engagement, with AI usage exerting a stronger influence, supporting H_1 and H_3.

Table 7. Model summary for the prediction of student engagement.

Model	R	R^2	Adjusted R^2	Std. Error of the Estimate	Durbin-Watson
1	0.55	0.30	0.29	0.86	0.69

Note: Predictors: (Constant), AI literacy, AI usage.
Dependent variable: Student engagement

Table 8. ANOVA summary for the prediction of student engagement.

Model	Sum of squares	df	Mean square	F	Sig.
Regression	96.51	2	48.25	63.80	0.000
Residual	220.86	292	0.75	-	-
Total	317.38	294	-	-	-

Note: Dependent Variable: Student Engagement
Predictors: (Constant), AI Literacy, AI Usage.

Table 9. Regression coefficients predicting student engagement.

Predictor	B	SE	β	t	p	95% CI for B	Tolerance	VIF
(Constant)	0.93	0.22	-	4.15	0.000	[0.48, 1.37]	-	-
AI Usage	0.40	0.06	0.37	6.64	0.000	[0.28, 0.53]	0.76	1.30
AI Literacy	0.30	0.06	0.26	4.79	0.000	[0.18, 0.43]	0.76	1.30

Note: Dependent Variable: Student Engagement.

4.3.2. Multiple Regression Analysis of AI usage and AI Literacy on Students' Creativity (H_2 & H_4)

A multiple linear regression to determine whether AI usage and AI literacy predict student creativity. The model (Table 10) showed R = 0.52, R^2 = 0.27, and adjusted R^2 = 0.26, indicating that the two predictors explain 27.0% of the variance. The Durbin–Watson value (1.76) suggested no serious autocorrelation. ANOVA (Table 11) confirmed the model's significance, F (2, 29) = 54.004, p < .001. Regression coefficients (Table 12) indicated that AI usage (B = 0.27, β = 0.29, t = 5.096, p < .001) and AI literacy (B = 0.30, β = 0.31, t = 5.470, p < .001) are both significant positive predictors, with AI literacy exerting a slightly stronger effect. Overall, higher AI usage and literacy significantly predict creativity, supporting H_2 and H_4, with AI literacy having a marginally stronger influence. R^2 = 0.27 indicates that AI literacy explains 27% of the variance in engagement. In practical terms, a one standard deviation increase in AI literacy predicts a 0.26 SD increase in student engagement, representing a moderate and educationally meaningful effect.

Table 10. Model summary for the prediction of student creativity.

Model	R	R^2	Adjusted R^2	Std. Error of the estimate	Durbin-Watson
1	0.52	0.27	0.26	0.76	1.76

Note: Predictors: (Constant), AI literacy, AI usage.
Dependent variable: Student creativity.

Table 11. ANOVA summary for the prediction of student creativity.

Model	Sum of squares	df	Mean Square	F	Sig.
Regression	62.62	2	31.31	54.00	0.000
Residual	169.30	292	0.58	-	-
Total	231.93	294	-	-	-

Note: Dependent variable: Student creativity.
Predictors: (Constant), AI Literacy, AI Usage.

Table 12. Regression coefficients predicting student creativity.

Predictor	B	SE	β	t	p
(Constant)	1.456	0.196	-	7.420	0.000
AI Usage	0.27	0.05	0.29	5.09	0.000
AI Literacy	0.30	0.05	0.31	5.47	0.000

Note: Dependent Variable: Student Creativity.

Drawing from the outcomes of the four sets of hypothesis tests, all paths (H_1–H_4) achieved statistical significance, validating the theoretical model of this study. Whether from the behavioral level (AI Usage) or the cognitive level (AI Literacy), artificial intelligence has played a positive role in promoting student engagement and stimulating student creativity. The research findings further confirm the synergistic impact of technology use and literacy on educational outcomes, indicating that future education should place greater emphasis on cultivating AI literacy and integrating tool application.

5. DISCUSSION

This study examined the influence of AI usage frequency and AI literacy on students' learning engagement and creativity, drawing on constructivist learning theory and student engagement theory. A theoretical model was developed with AI usage and literacy as independent variables and student engagement and creativity as dependent variables. Regression analyses using SPSS 27.0 validated all four hypotheses (H_1–H_4), confirming AI's significant role in enhancing students' active learning and innovative abilities (Xing & Jiang, 2025).

5.1. The application of Artificial Intelligence Notably Enhances Students' Engagement in the Learning Process (Response to RQ1)

The results showed that AI usage frequency had a significant positive effect on learning engagement ($\beta = 0.37$, $p < .001$), supporting H_1. Further analysis revealed that "AI platforms enhance learning interest" (Q12) was the sole significant predictor ($\beta = 0.18$, $p = 0.04$), underscoring the importance of interest-driven technology adoption. This finding aligns with student engagement theory, which defines engagement across emotional, behavioral, and cognitive dimensions (Lin & Chen, 2024). From a constructivist perspective, AI platforms provide feedback-rich, exploratory environments, enabling students to actively construct knowledge (Kim et al., 2025). Prior research also shows AI recommendation systems in flipped classrooms enhance motivation (Huang, Lu, & Yang, 2023) and build trust in educational systems, sustaining engagement (Liu, Jiang, & Zoghi, 2025).

5.2. AI Usage Behavior Promotes Students' Creativity Development (Response to RQ2)

AI usage frequency significantly predicted creativity ($\beta = 0.29$, $p < .001$), validating H_2. "AI inspires me to generate new ideas" (Q16) emerged as the only significant predictor ($\beta = 0.24$, $p = 0.006$), while "producing high-

quality original works" (Q20) was nonsignificant. Students thus see AI as an "inspiration partner" rather than a "writing machine," using it to stimulate divergent thinking. Constructivist learning theory and the Technology Acceptance Model (TAM) explain that perceived usefulness encourages adoption for creative tasks (León-Garrido, Gutiérrez-Castillo, Barroso-Osuna, & Cabero-Almenara, 2025; Li et al., 2024). Related studies also note AI shifts creativity from a product-oriented to process-oriented model (Mehrad & Mehrad, 2024), supporting this study's conclusion that process-oriented thinking drives creative development.

5.3. AI Literacy Significantly Improves Student Engagement in Learning (Response to RQ3)

AI literacy significantly predicted learning engagement ($\beta = 0.26$, $p < .001$), confirming H_3. Students with greater AI knowledge, skills, and ethical awareness showed higher emotional, behavioral, and cognitive engagement. Student engagement theory suggests that engagement stems from both environmental and cognitive factors (Kim et al., 2020), and AI literacy strengthens students' control over the learning environment. From a constructivist view, AI literacy reflects the ability to continuously construct meaning during learning (Lan & Zhou, 2025). Beyond individual gains, improving AI literacy may also address equity gaps in technology-enabled education (Guo & Rong, 2025; Hu & Liu, 2023).

5.4. AI Literacy has a Significant Promotional Effect on Students' Creativity (Response to RQ4)

AI literacy also positively predicted creativity ($\beta = 0.31$, $p < .001$), supporting H_4. High AI literacy enables students to use AI tools more effectively for creative purposes, enhancing idea generation and diversity. TAM suggests that perceived usefulness and ease of use foster adoption and confidence (Jia & Tu, 2024; Mat Yusoff, Mohamad Marzaini, Hao, Zainuddin, & Basal, 2025). This aligns with the model in Chapter 2, where AI literacy in the cognitive pathway drives creative exploration. Enhancing AI literacy thus requires integrating skill development with motivational factors, progressing through "understanding–trust–creation" stages (Acosta-Enriquez et al., 2025).

5.5. AI use and Literacy Synergistically Promote Student Learning and Creative Development (Response to RQ5)

Both AI usage and AI literacy significantly influence learning engagement and creativity, but with different strengths: AI usage more strongly predicts engagement, while AI literacy more strongly predicts creativity. This dual-pathway mechanism suggests instruction should shift from tool-oriented to motivation-oriented approaches, embedding interactive and creative AI scenarios into curricula. The application of the DeepSeek system in Guangdong vocational colleges provides empirical support for AI's value in education (Zhang et al., 2025).

6. IMPLICATIONS

This study confirms that AI usage and literacy significantly influence student engagement and creativity, clarifying learning mechanisms in AI-supported environments. Guided by constructivist learning theory and the Technology Acceptance Model (Timotheou et al., 2023), it identifies AI literacy as a bridge connecting digital literacy, acceptance, and motivation. AI-driven, gamified instruction fosters interaction and learning outcomes (Almusaed, Almssad, Yitmen, & Homod, 2023). Teachers should use AI as a cognitive partner, not just a tool, while schools must embed operational, evaluative, and ethical AI skills into curricula (Dabbagh et al., 2025). EdTech design and AI ethics education are key to promoting responsible, equitable use (Tsang, 2025).

7. RECOMMENDATION

This study confirms that both AI usage frequency and AI literacy significantly enhance students' engagement and creativity, highlighting AI's value in promoting motivation, cognition, and expression. Students should build AI literacy by mastering technical skills, understanding AI logic, and cultivating ethical awareness. Purposeful use of AI for exploration, self-assessment, and generative tasks can foster autonomous learning. Teachers should utilize AI to

design personalized, interest-driven tasks using recommendation and feedback functions, shifting roles from transmitters to facilitators (Dabbagh et al., 2025). At the systemic level, AI literacy, including technical, ethical, and critical dimensions, should be embedded in curricula. Policymakers must establish clear guidelines and invest in AI infrastructure and training to address the digital divide and promote equitable, intelligent education (Tsang, 2025).

8. CONCLUSION

This study demonstrates that AI literacy and AI usage significantly predict student engagement and creativity in vocational accounting education. Its contribution lies in extending AI literacy research into a vocational and discipline-specific setting, integrating technology adoption perspectives with educational outcomes. Practically, the study underscores the need to embed AI training and support into vocational curricula and leadership strategies. These findings not only strengthen the theoretical understanding of AI's role in education but also provide actionable insights for policy and practice in vocational higher education.

Funding: The authors received no financial support for the research.
Institutional Review Board Statement: The study is approved by the Ethical Committee of the INTI International University, Malaysia, under protocol number [I24029004], dated [8th July 2025]. Informed verbal consent was obtained from all participants, and all data were anonymized to protect participant confidentiality.
Transparency: The authors state that the manuscript is honest, truthful, and transparent, that no key aspects of the investigation have been omitted, and that any differences from the study as planned have been clarified. This study followed all writing ethics.
Competing Interests: The authors declare that they have no competing interests.
Authors' Contributions: All authors contributed equally to the conception and design of the study. All authors have read and agreed to the published version of the manuscript.
Disclosure of AI Use: The author(s) used ChatGPT to edit and refine the wording of the manuscript. All outputs were reviewed and verified by the authors.

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