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AI-Enhanced Teaching and Student Creative Thinking: Evidence from Middle School Classrooms

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Abstract

There has been an increase in global investment in the integration of artificial intelligence (AI) into K-12 education. However, there is no empirical evidence of the relationship between teachers' domain-specific AI practices and student creative thinking outcomes (particularly in non-Western contexts). This study seeks to address this gap by providing the first known empirical, multi-dimensional, correlational evidence demonstrating links between the way 8th-grade teachers use AI in their practice and students' creative thinking in Abu Dhabi, UAE. This study uses the SAMR model and the Componential Theory of Creativity to provide a descriptive–correlational research design using a purposive (30) sample of 8th-grade teachers and a random (150) sample of students from their classes. Two newly developed and validated measurement instruments (the Teachers' AI Application Use Questionnaire and the Students' Creative Thinking Questionnaire) were used to conduct the analysis of the data collected. The findings from the analysis provide four main novel contributions to the body of research. First, the results demonstrate a positive correlation between teachers' overall use of AI and the students' creative thinking. Second, within the model used, delivery and assessment-and-feedback were the only two domains that were statistically significant predictors in the regression analysis, which has not been previously established. Third, data from students indicated that although there were significant fluency and flexibility scores, they also had a significant deficit in originality, providing an important theoretical gap in the body of research; and fourth, the ACIC (AI–Creativity Integration Continuum) was developed and empirically validated through this study. The ACIC proposes three conceptual pathways (cognitive offloading, generative scaffolding, and reflective amplification) through which teachers' AI integration may be associated with students' creative thinking development.

Keywords: artificial intelligence; creative thinking; SAMR model; teacher technology integration; componential theory of creativity



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1. Introduction

Although educational technology research has devoted considerable effort to answer the question of whether, and to what degree, teachers' use of AI applications has created measurable improvements in the creative thinking of students, little empirical evidence supports this relationship. The desire to incorporate AI tools into classroom instruction has increased exponentially over the past few years (Alarabi et al., 2025a; Zawacki-Richter et al., 2019; Hamdan & Yassine-Hamdan, 2026); however, few empirical studies of AI

have been conducted to date. The current literature primarily reports teacher perception of AI adoption (Alarabi et al., 2025b; Al-Marooof et al., 2021) or generalized academic outcome measures, without separating creativity as a dichotomous variable. Therefore, this relationship is important to further explore, because creative thinking is increasingly seen as the premier cognitive competency for participation in the 21st-century workforce (Alarbi et al., 2024; Alsuwaidi et al., 2025; Holmes et al., 2019). Importantly, to date, no AI-creativity study has examined the dimensions of teacher AI use and the four-factor structure of student creative thinking. Furthermore, the research completed to date regarding AI-creativity relationships has been conducted only in Western countries; the current study was therefore developed to address both of these gaps.

Within this context, the United Arab Emirates (UAE) is uniquely positioned. As part of its national AI Strategy 2031, the UAE has committed itself to the integration of AI within all sectors of the country, with education being identified as a priority area (Rabbani et al., 2023). Furthermore, the Abu Dhabi Department of Education and Knowledge (ADEK) has implemented numerous innovative strategies into its approximately 1083 schools that provide services to about 326,000 students (Alarabi et al., 2024); therefore, there are strong policy mandates supporting the goal of creating AI-enhanced learning environments throughout the UAE. However, while there are guidelines for the integration of AI in education, studies indicate that there is a statistically significant differences in teachers' application of AI compared to traditional teacher instructional practices (Al Zaabi et al., 2026; Taani et al., 2025), there is still a paucity of research that establishes a causal relationship between teachers' use of AI at the classroom level and corresponding student creative thinking scores within Abu Dhabi's public school systems (Al-Marooof et al., 2021).

Eighth grade is particularly important to develop students' creative thinking. Mid-adolescence (i.e., 11–15 years old) is characterized by large amounts of growth in the neural plasticity of prefrontal cortex regions that govern divergent thinking and cognitive flexibility (Kleibeuker et al., 2013). Furthermore, this time period corresponds to the transition from Piaget's concrete operational reasoning stage (ages 7–11) to Piaget's formal operational reasoning stage (ages 11–15), resulting in an ideal educational environment that would enable Grade 8 students to capitalize on generative AI's problem-solving capabilities. Unfortunately, no empirical studies to date have examined AI's creative impact on Grade 8 scholars attending public or government schools in UAE.

The study contributes to the body of research in two ways. First, this study provides the first empirical multi-dimensional correlational evidence showing that Grade 8 teachers' use of AI applications (across four domains of practice, i.e., pedagogical planning (Pedg. Plan), instructional delivery (Inst. Delivery), assessment-and-feedback (Ass. & Fed), and professional development (PD)) is positively correlated with Grade 8 students' creative thinking (fluency, flexibility, originality and elaboration) within the public school system of the Emirate of Abu Dhabi. Second, the study proposes the initial version of the newly developed AI-Creativity Integration Continuum (ACIC) and empirically tests the continuum. The ACIC is a new theoretical framework that combines the technology integration theories described in the SAMR model (Hamilton et al., 2016) and Amabile's (2018) Componential Theory of Creativity; the ACIC proposes a conceptual framework describing potential associations between teachers' integration of AI and student creative development. Unlike existing theories/frameworks that describe AI-creativity relationships, the ACIC offers a hierarchical approach to clearly identify and predict specific dimensions of AI use that should provide the greatest predictive power for creativity.

1.1. Statement of the Problem

Despite the significant investment made by the UAE on behalf of its citizens to encourage the incorporation of AI into education systems and the potential for utilizing AI to improve creative thinking skills in students, there are still two converging gaps in our knowledge base. The first is the documented difference found within the literature between the described extent of AI integration into education systems and the documented level of AI integration/implementation in teachers' classrooms (Alarabi et al., 2025a; Al-Marooof et al., 2021). The second gap in the literature is an empirical determination of the specific effect of AI on Grade 8 students' cognitive outcomes when utilizing technology-enhanced pedagogy as an instructional strategy. These identified gaps can result in policy makers being unable to determine whether the implementation of integrating AI into Abu Dhabi education systems leads to the generation of the expected cognitive returns. Therefore, this study seeks to answer the following questions:

RQ1: What is the level of teachers' use of AI applications in Abu Dhabi Grade 8 schools?

RQ2: What is the level of creative thinking among Grade 8 students in Abu Dhabi schools?

RQ3: Is there a statistically significant correlational relationship between teachers' AI application use and students' creative thinking levels?

RQ4: Which dimensions of teachers' AI application use are the strongest predictors of students' creative thinking?

1.2. Significance of the Study

This study has four significant contributions that represent significant forward movement with regard to prior work within the field of educational technology. (1) Theoretical contribution of novelty: The ACIC is the first theoretical framework to integrate the technology integration theory (SMAR) level of the SAMR model with the Componential Theory of Creativity to generate testable hierarchical predictions regarding AI-creativity linkages; no other theoretical frameworks/modules address both concepts in totality. (2) Empirical contribution of novelty: This is the first study to establish a statistically significant dimension-specific relationship between teachers' use of AI and students' creative thinking in a GCC context ($r = 0.54$, $p < 0.001$, $\Delta R^2 = 0.28$); therefore, it represents the first evidence indicating that instructional delivery and assessment-and-feedback emerged as the dimensions most strongly associated with students' creative thinking in terms of predicting students' creative thinking, thus directly impacting education policy regarding this area of teacher practice. (3) Methodological contribution: Two new measurement tools; the Teachers' AI Application Use Questionnaire (TAAUQ) and Students' Critical Thinking Questionnaire (SCTQ) (both with $\alpha > 0.93$, $CFI > 0.92$), have been created and validated for use in the Arabic-speaking population of the UAE educational context. (4) Practical contribution: Actionable data concerning dimension-level aspects of AI-specific use will assist ADEK in developing priority areas for future professional development and thus provide the greatest return on investment to teachers pertaining to creativity through AI.

2. Literature Review

2.1. Theoretical Foundations

2.1.1. The SAMR Model

As developed by Hamilton et al. (2016), the SAMR model defines a hierarchy of four levels within which technology can be used, ranging from less creative to more creative uses. The levels are: (1) Substitution (direct replacement of a tool) and Augmentation (functionally improved direct replacement of a tool); (2) Modification (significant redesign of a task); and (3) Redefinition (newly conceived task). The research indicates that creativity is most positively associated with the highest levels of the SAMR model (Hamilton et al.,

2016). When utilizing AI technology, teachers may employ lower-level AI tools (drill-and-practice type) at the levels of Substitution and Augmentation to support students in their learning. In contrast, teachers utilize the higher levels of the SAMR model (Modification and Redefinition) to support students as they continue to grow in an inquiry-based environment that also utilizes AI as a partner.

The SAMR model was selected as the primary technology integration framework because it conceptualizes technology use as a progression from enhancement-oriented practices to transformational learning experiences (Hamilton et al., 2016). This distinction is particularly relevant to artificial intelligence applications, which can be used either as simple productivity tools or as transformative partners in knowledge creation. Since the purpose of the present study is to examine how teachers' AI use relates to students' creative thinking, a framework capable of differentiating levels of pedagogical integration is required. Unlike technology acceptance models that focus on users' perceptions or intentions, the SAMR framework focuses directly on instructional practice and therefore provides a suitable lens for examining how AI-supported teaching may foster different levels of creativity.

2.1.2. The Componential Theory of Creativity

Amabile's (2018) Componential Theory of Creativity explains that for a person to be creative, there must be certain conditions within the individual: (1) domain-relevant skills; (2) creativity-relevant processes; and (3) intrinsic task motivation. Each of these components will vary according to environmental influences. Thus, componential theory is relevant to AI-mediated learning in that AI tools can scaffold the three intraindividual components: (1) Scaffolding means increasing a teacher's knowledge; (2) Using generative prompts, AI tools can assist in the modeling of divergent heuristics; and (3) Providing personalized, immediate feedback will aid in improving a student's motivation to continue learning (Liu et al., 2022).

2.1.3. The AI–Creativity Integration Continuum (ACIC)

The ACIC proposes that the relationship between AI integration and creativity depends on the pedagogical function of AI rather than its mere use. While AI can support routine activities such as information retrieval, practice, and task automation, these applications may not necessarily foster creative thinking. In contrast, AI applications that facilitate inquiry, idea generation, iterative feedback, reflection, and task redesign may create conditions that are more supportive of creativity. Therefore, the ACIC hypothesizes that AI uses aligned with modification and redefinition processes are more likely to be associated with higher levels of student creative thinking than uses focused primarily on efficiency or procedural support. The present study seeks to empirically test this prediction.

The ACIC framework extends the SAMR model by explaining not only the depth of AI integration but also the specific cognitive and creative processes through which AI-enhanced instructional practices influence students' creative development. Whereas SAMR identifies levels of technology integration, the ACIC identifies the mechanisms that translate those levels into creative outcomes (see Table 1).

Combining Amabile's Componential Theory and Hamilton's SAMR model, the present study proposes ACIC as a tool to examine how teachers use AI to develop students' creative thinking. The ACIC describes three progressive mechanisms in which teachers' use of AI fosters the development of students' creative thought:

1. Cognitive Offloading (SAMR: Substitution–Augmentation)—By utilizing AI tools, teachers can reduce the amount of daily cognitive effort required to complete certain tasks (e.g., retrieve information, perform basic calculations) so that students have greater

availability of capacity in working memory and are able to engage in higher levels of creative thought (Risko & Gilbert, 2016).

2. Generative Scaffolding (SAMR: Augmentation–Modification)—In this context, teachers use AI tools as an active scaffold for supporting divergent thinking by providing students with generative prompts, representing multiple perspectives, and/or offering dynamic feedback that has extended students’ repertoire of ideational possibilities (Sawyer, 2012). When teachers use AI to assist in formatively assessing student learning and to generate personalized questions, they work at this level.

3. Reflective Amplification (SAMR: Modification–Redefinition)—Reflective amplification using AI enables students to iteratively generate meta-cognitive reflections through the process of critically comparing AI-generated output to their own, assessing distinctiveness of human insight and pursuing original products through iteration (Hennessey & Amabile, 2010). To engage students in this level of cognitive development, teachers utilize project-based learning experiences that require a student to critique and refine their own work through an evaluation of AI characteristics.

Table 1. Alignment of the SAMR Framework and the ACIC.

SAMR Level	ACIC Mechanism	Example of AI Use
Substitution	Cognitive Offloading	ChatGPT summarizes a text or generates notes
Modification	Generative Scaffolding	Students use AI to brainstorm multiple solutions and receive formative feedback
Redefinition	Reflective Amplification	Students co-create projects with AI, critique AI-generated responses, and refine original products

2.2. Empirical Studies

In their systematic review of the literature related to AI applications, Zawacki-Richter et al. (2019) found that adaptive learning and intelligent tutoring systems were the most frequently utilized AI modalities. Both types of AI techniques provide benefits mostly related to the facilitation of declarative knowledge acquisition, with few applications providing benefits related to the facilitation of higher-order cognitive performance outcomes. Popenici and Kerr (2017) noted that most currently deployed AI applications were implemented using the SAMR model level of substitution, thus limiting the application of transformative creative outcomes to an aspirational basis. More recently, in their meta-analysis of 50 studies examining the impact of multimedia technologies on creative performance, Liu et al. (2022) determined that overall, multimedia technologies that require high levels of active human–computer interaction have a moderate positive effect in facilitating creative performance when compared to traditional learning environments. Additionally, Huang et al. (2019) found that when AI is used as a component of structured inquiry experiences, with scaffolding in place, students produced meaningful increases in quantity and quality of creative outcomes when compared to inquiry-based approaches that do not use technology or utilize technology without structure.

In relation to the context of the Gulf Cooperation Council (GCC) region, the findings of Al-Marroof et al. (2021) provided evidence of perceived ease of use and perceived pedagogical relevance as predictive factors of voluntary adoption of AI among university students in the United Arab Emirates; however, the study only examined perception data rather than reported any student creativity measures. Finally, Al-Emran et al. (2016) found that there was a significant positive association between student engagement and mobile

learning technologies in education; however, no creativity information was provided. Thus, the present study aims to address the above gaps and specifically focus on an eighth-grade student population, as well as use validated creativity measures.

Current scholarly consensus indicates that creative thinking is represented by four measurable dimensions (fluency, flexibility, originality, elaboration) as outlined by Guilford (1967) and Torrance (1974). Scott et al. (2004) conducted a meta-analysis of 70 studies that provided evidence that creativity training programs yielded an average increase of (mean difference $\Delta = 0.64$). Said-Metwaly et al. (2017) used Torrance's (1974) structure in a cross-cultural study and reported a robust four-factor structure for creative thinking across the range of cultures studied including Middle Eastern countries. Given that many teachers act as "creativity gatekeepers," it is proposed that teachers' utilization of AI has the potential to drive increases in students' creative outcomes.

Future investigations should directly measure the mediating mechanisms proposed by the ACIC framework. Experimental and longitudinal designs, combined with mediation or structural equation modeling analyses, would enable researchers to determine whether cognitive offloading, generative scaffolding, and reflective amplification are the processes through which AI-enhanced teaching influences students' creative thinking.

3. Method

This study employed a quantitative descriptive–correlational design. Descriptive analysis characterized teachers' AI use and students' creative thinking in naturalistic classroom contexts. Correlational analysis examined the direction and magnitude of the relationship between these variables (Creswell & Creswell, 2018). Multiple regression analysis identified which AI use dimensions most strongly predicted creative thinking. Because this study employed a cross-sectional descriptive–correlational design, the findings should be interpreted as evidence of association rather than causation.

3.1. Population and Sample

The target population comprised all Grade 8 teachers in Abu Dhabi Emirate schools during 2023–2024 (approximately 2400 teachers across government, semi-government, and private schools; Alarabi et al., 2024). A purposive sample of 30 Grade 8 teachers was selected to represent varied school types, geographic zones, and subject specializations. Five students were systematically randomly selected from each teacher's class roster, yielding $N = 150$ students. Sample size adequacy was confirmed using G*Power 3.1 (Faul et al., 2007): for $r = 0.30$, $\alpha = 0.05$, and power = 0.80, the minimum required $N = 84$; the obtained $N = 150$ provides power exceeding 0.95. Table 2 presents the demographic characteristics of both samples.

3.2. Instruments

3.2.1. Teachers' AI Application Use Questionnaire (TAAUQ)

The TAAUQ (40 items, 4 dimensions) was created using literature reviews and examples from the SAMR Framework. It consists of four dimensions: Pedagogical Planning (10 items), Instructional Delivery (10 items), Assessment and Feedback (10 items), and Professional Development (10 items), with all answers rated using a 5-point Likert scale with ratings of (1) = Never to (5) = Always. An expert panel of 10 people (i.e., specialist raters) established content validity ($CVR = 0.89$, $CVR > 0.062$). Construct validity was established using a Confirmatory Factor Analysis (CFA). The CFA results indicated a good fit ($CFI = 0.94$, $RMSEA = 0.057$, $SRMR = 0.063$). Internal consistency of the four dimensions was as follows: Pedagogical Planning ($\alpha = 0.87$), Instructional Delivery ($\alpha = 0.89$), Assessment and Feedback ($\alpha = 0.86$), Professional Development ($\alpha = 0.83$), and Overall

($\alpha = 0.94$). Based on their recommendations, several items were reworded to improve clarity, AI-related terminology was standardized, and minor modifications were made to strengthen alignment with the underlying theoretical framework.

Table 2. Demographic Characteristics of Teacher and Student Samples.

Variable	Category	Number of Teachers and (%)	Number of Students and (%)
Gender	Male	14 (46.7%)	76 (50.7%)
	Female	16 (53.3%)	74 (49.3%)
School Type	Government	15 (50.0%)	75 (50.0%)
	Private National	8 (26.7%)	40 (26.7%)
	Private International	7 (23.3%)	35 (23.3%)
Zone	Abu Dhabi City	15 (50.0%)	75 (50.0%)
	Al Ain	10 (33.3%)	50 (33.3%)
	Al Dhafra	5 (16.7%)	25 (16.7%)
Teaching Experience	1–5 years	8 (26.7%)	—
	6–10 years	11 (36.7%)	—
	>10 years	11 (36.7%)	—
AI Training	Formal training	19 (63.3%)	—
	Self-taught	11 (36.7%)	—

Note. Teacher experience and AI training data were not applicable (—) for student participants.

3.2.2. Students' Critical Thinking Questionnaire (SCTQ)

The SCTQ (36 items, 4 dimensions) was created based on Torrance's Model of Creative Thinking (Torrance, 1974, 2008), with dimensions consisting of Fluency (9 items), Flexibility (9 items), Originality (9 items), and Elaboration (9 items). All questions were evaluated on a 5-point scale (1 = Strongly Disagree–5 = Strongly Agree) in a clear Arabic script. To ensure linguistic and cultural appropriateness, the SCTQ was reviewed by two senior Arabic language specialists with expertise in educational linguistics and curriculum studies. Their feedback led to minor modifications in wording and sentence structure to enhance clarity and appropriateness while preserving the intended constructs. The revised version demonstrated strong content validity (CVR = 0.86). A CFA indicated that there was a good fit between the SCTQ and the structural model (CFI = 0.92, RMSEA = 0.061, SRMR = 0.068). The four dimensions also exhibited good internal consistency with the following alpha coefficients: Fluency ($\alpha = 0.84$), Flexibility ($\alpha = 0.86$), Originality ($\alpha = 0.83$), Elaboration ($\alpha = 0.81$), and Overall ($\alpha = 0.93$). Test–retest reliability was assessed for 30 students over a 2-week period ($r = 0.78, p < 0.001$).

3.3. Data Collection Procedures and Analysis

Data was collected within 8 weeks (October to December 2023) following ethical clearance from the participating school. The teachers completed TAAUQ electronically via Lime Survey. Student questionnaires were administered during the class on paper; trained research assistants provided a consistent and standardized environment for the students. Informed consent was obtained from all participants who were adults and from parents/guardians of the students; student assent was also obtained.

Data was analyzed using the IBM SPSS Statistics version 28 and AMOS version 26. Descriptive statistics were computed, and the following Likert mean benchmark values were utilized 1.00 to 2.33 = Low; 2.34 to 3.66 = Moderate; 3.67 to 5.00 = High. Pearson Correlations were calculated to assess the bivariate relationship between the variables. Hierarchical multiple regression analyses were performed using the overall creative thinking score as the dependent variable and the four AI use dimensions as the independent variables, while controlling for both teacher experience and school type. Prior

to performing regression analyses, statistical assumptions of normality, homogeneity of variance, and multicollinearity were verified. Alpha level was set below 0.05.

4. Results

4.1. RQ1: Level of Teachers' AI Application Use

Table 3 provides descriptive statistics related to teachers' use of AI applications; overall, teachers had a high level of use of AI applications ($M = 3.72$, $SD = 0.61$). Pedagogical Planning ($M = 3.81$) and Professional Development ($M = 3.80$) had the highest ratings; Assessment and Feedback ($M = 3.59$) was on the upper bound of moderate.

Table 3. Descriptive Statistics for Teachers' AI Application Use ($N = 30$).

Dimension	M	SD	Min	Max	Level
Pedagogical Planning (Pedg. Plan)	3.81	0.64	2.40	5.00	High
Instructional Delivery (Inst. Delivery)	3.68	0.72	2.10	5.00	High
Assessment and Feedback (Ass. & Fed)	3.59	0.69	1.90	4.90	Moderate
Professional Development (PD)	3.80	0.58	2.50	5.00	High
Overall AI Use	3.72	0.61	2.23	4.97	High

Note. M = mean; SD = standard deviation. 1.00–2.33 = Low, 2.34–3.66 = Moderate, 3.67–5.00 = High.

4.2. RQ2: Level of Students' Creative Thinking

Students demonstrated moderate creative thinking across all four dimensions (Overall $M = 3.45$, $SD = 0.58$; see Table 4). Fluency received the highest rating ($M = 3.52$), while Originality received the lowest ($M = 3.31$), suggesting that generating genuinely novel ideas presented the greatest challenge. Kolmogorov–Smirnov tests confirmed approximately normal distributions for all dimensions ($p > 0.05$), supporting the use of parametric inferential statistics.

Table 4. Descriptive Statistics for Students' Creative Thinking ($N = 150$).

Dimension	M	SD	Min	Max	Level
Fluency	3.52	0.63	1.89	5.00	Moderate
Flexibility	3.48	0.61	2.00	4.89	Moderate
Originality	3.31	0.66	1.67	4.78	Moderate
Elaboration	3.49	0.59	2.00	4.89	Moderate
Overall Creative Thinking	3.45	0.58	1.92	4.88	Moderate

Note. M = mean; SD = standard deviation. 1.00–2.33 = Low, 2.34–3.66 = Moderate, 3.67–5.00 = High.

4.3. RQ3: Correlational Relationship Between AI Use and Creative Thinking

Table 5 presents Pearson correlation coefficients. A statistically significant positive correlation was found between overall AI use and overall creative thinking ($r = 0.54$, $p < 0.001$). All dimension-level correlations were also significant ($p < 0.05$ or $p < 0.001$). Among AI use dimensions, Instructional Delivery demonstrated the strongest correlation with overall creative thinking ($r = 0.54$), followed by Assessment and Feedback ($r = 0.48$), Pedagogical Planning ($r = 0.43$), and Professional Development ($r = 0.39$). Among creative thinking dimensions, Fluency showed the strongest association with overall AI use ($r = 0.51$), while Originality showed the weakest ($r = 0.42$), consistent with the expectation that originality represents the most cognitively demanding creative component.

Table 5. Pearson Correlation Matrix: Teachers' AI Use and Students' Creative Thinking Dimensions.

Variable	1	2	3	4	5	6	7	8	9
Pedg. Plan	—								
Inst. Delivery	0.71 **	—							
Ass. & Fed	0.68 **	0.73 **	—						
PD	0.62 **	0.59 **	0.64 **	—					
Overall AI Use	0.88 **	0.91 **	0.87 **	0.79 **	—				
Fluency	0.41 **	0.49 **	0.43 **	0.37 *	0.51 **	—			
Flexibility	0.38 *	0.46 **	0.40 **	0.33 *	0.48 **	0.72 **	—		
Originality	0.29 *	0.39 **	0.36 *	0.28 *	0.42 **	0.68 **	0.71 **	—	
Elaboration	0.36 *	0.44 **	0.47 **	0.35 *	0.50 **	0.70 **	0.69 **	0.66 **	—
Overall CT	0.43 **	0.54 **	0.48 **	0.39 *	0.54 **	0.89 **	0.87 **	0.82 **	0.84 **

Note. CT = Creative Thinking. * $p < 0.05$. ** $p < 0.001$.

4.4. RQ4: Predictors of Student Creative Thinking

Hierarchical multiple regression results are presented in Table 6. After controlling for teacher experience and school type ($R^2 = 0.06$, $p = 0.010$), the four AI use dimensions explained an additional $\Delta R^2 = 0.28$ ($p < 0.001$) in students' creative thinking variance, for a total model $R^2 = 0.34$ (Adjusted $R^2 = 0.31$). Instructional Delivery ($\beta = 0.38$, $t = 4.14$, $p < 0.001$) and Assessment and Feedback ($\beta = 0.29$, $t = 3.14$, $p = 0.002$) were statistically significant predictors. Pedagogical Planning ($\beta = 0.11$, $p = 0.185$) and Professional Development ($\beta = 0.13$, $p = 0.156$) did not reach significance. Variance inflation factors ranged from 1.67 to 2.34, confirming no problematic multicollinearity.

Table 6. Hierarchical Multiple Regression: Predictors of Students' Creative Thinking ($N = 150$).

Predictor	B	SE	β	t	p	ΔR^2
Step 1: Control Variables						0.06 *
Teacher Experience	0.04	0.03	0.09	10.33	0.185	
School Type (Private vs. Gov.)	0.11	0.07	0.12	10.57	0.118	
Step 2: AI Use Dimensions						0.28 **
Pedagogical Planning	0.08	0.06	0.11	10.33	0.185	
Instructional Delivery	0.29	0.07	0.38	40.14	<0.001	
Assessment and Feedback	0.22	0.07	0.29	30.14	0.002	
Professional Development	0.10	0.07	0.13	10.43	0.156	
Total R^2	0.34					
Adjusted R^2	0.31					

Note. B = unstandardized coefficient; SE = standard error; β = standardized coefficient. * ΔR^2 $p < 0.05$. ** ΔR^2 $p < 0.001$.

5. Discussion

This study makes several important contributions to the growing body of literature on artificial intelligence in education and creativity development. First, it provides one of the earliest empirical investigations of the relationship between teachers' AI application use and students' creative thinking in a Gulf Cooperation Council (GCC) educational context, addressing a notable geographical gap in current research. Second, unlike previous studies that have primarily focused on teachers' perceptions or general educational outcomes (Alarabi et al., 2025a; Zawacki-Richter et al., 2019; Alarabi et al., 2025b; Al-Marooof et al., 2021), the present study demonstrates that specific dimensions of AI integration—particularly instructional delivery and assessment-and-feedback—are significant predictors of students' creative thinking. Third, this study introduces and offers initial empirical

support for the newly proposed AI–Creativity Integration Continuum (ACIC), a theoretical framework that integrates the SAMR model with Amabile’s Componential Theory of Creativity to explain the mechanisms through which AI-enhanced teaching can foster creative development. Finally, the study contributes methodologically through the development and validation of two contextually appropriate instruments for measuring teachers’ AI application use and students’ creative thinking in Arabic-speaking educational settings. Collectively, these contributions extend the current literature by moving beyond the question of whether AI matters in education to examine how particular forms of AI integration influence students’ higher-order cognitive outcomes.

5.1. Teachers’ AI Integration

While overall usage of AI ($M = 3.72$) across the population is encouraging and shows consistency with the national investment in AI within the UAE, dimensions of AI use within the framework of the AI–Creativity Integration Continuum (ACIC) warrant additional consideration as they represent theory and therefore show meaningful variation in performance across the five dimensions measured via teachers’ AI applications (i.e., Integration of AI into Assessment and Feedback versus Pedagogical Planning and Professional Development). With pedagogical planning and professional development being significantly better performing dimensions than that of assessment-and-feedback ($M = 3.59$ versus $M = 3.72$), it can be inferred that teachers are currently more comfortable utilizing AI for behind-the-scenes preparation than they are for real-time formative assessment; indeed, instructional assessment mode identified in the analysis (i.e., real-time formative assessment) is found via regression analysis to be the strongest predictor of generating creative outcomes for students. There is extensive literature regarding teachers’ integration of technology into education, which supports the notion that teachers predominantly apply the use of digital tools at the level of substitution (addition of technology to perform the same task versus performing task using technology differently) and not modification (performing task differently using technology) or redefinition (creative vs. non-creatively) (Aleksieva et al., 2025; Abildinova et al., 2024; Zou et al., 2025). It is posited that the ACIC’s models of generative augmenting and reflective amplification (which exist in practice through the delivery of instruction and assessment practices) lend themselves to cognition-offloading (Hong et al., 2025; Zhao et al., 2025); therefore, while the use of AI in instruction is a valid practice, it is insufficient to achieve optimal levels of creativity in students when used in such a manner.

5.2. Students’ Creative Thinking

Regarding the measure of students’ creative thinking, the mean score of (3.45 for creative thinking) falls in line with previously documented findings (Abdulla & Cramond, 2017) regarding the moderate creative thinking abilities of Arab youth. The lower level of the mean score (3.31) received for the dimension of originality is particularly worth noting. Originality, the generation of rare, novel, statistically infrequent ideas, is the dimension of creative thought that relies most heavily on the educational environment in which education takes place; specifically, those environments which encourage generating creative thoughts through open-ended/ambiguous problems and rewarding students for those divergent thinking processes (Alarabi et al., 2025b; Kaufman & Sternberg, 2010; Rabbani et al., 2023). Thus, the present finding may indicate that while current educational practices appear to support dimensions such as fluency and flexibility, originality remains comparatively less developed among the participating students. However, given the correlational nature of the study and the relatively moderate differences between creativity dimensions, this observation should be interpreted cautiously as a potential area for further investigation

rather than as evidence requiring immediate changes in educational assessment philosophy or classroom practices. Future longitudinal and experimental research is needed to examine whether specific AI-enhanced pedagogical and assessment approaches can effectively foster originality.

5.3. The AI–Creativity Relationship

This study's primary empirical outcome is the observation of a significant positive association ($r = 0.54$, $p < 0.001$) between teachers' use of AI in their classrooms and Grade 8 students' ability to demonstrate creativity; results consistent with the findings from Liu et al. (2022) (i.e., a meta-analytic study reporting on the average association between AI and creativity in the literature = $g = 0.59$). Based on Cohen's guidelines for evaluating strength of relationships (Cohen, 1988), learners' ability to demonstrate creativity using a measure of AI integration shall be attributed to the presence of a large effect (i.e., $0.54 =$ large effect size). The regression model indicated that AI use dimensions were associated with an additional 28–29% of the observed variance in students' creative thinking scores after controlling for teacher experience and school type. Given the cross-sectional correlational design, these findings should not be interpreted as evidence of causation. While the observed correlation provides meaningful evidence of an association between teachers' AI integration practices and students' creative thinking, it should be interpreted with appropriate caution because both constructs were measured using questionnaire-based instruments. The findings therefore reflect students perceived creative thinking rather than direct assessments of creative performance, highlighting the need for future research employing objective creativity measures.

While previous studies have primarily focused on AI–creativity relationships, the current study moves beyond merely replicating this AI–creativity relationship to investigate how teachers' use of AI specifically predicts different dimensions of students' creative thinking. The findings of the present research indicate that although the overall dimensions of AI use are positively related (similar to past studies), only two specific AI use dimensions (i.e., instructional delivery ($\beta = 0.38$) and assessment-and-feedback ($\beta = 0.29$)) uniquely predict the students' creative thinking scores, while the dimensions of pedagogical planning and professional development did not uniquely predict students' creative thinking scores when controlled through hierarchical regression.

These findings provide initial empirical evidence that is consistent with the ACIC's hierarchical predictions. However, because the study did not directly operate the proposed cognitive mechanisms underlying the model, the present results should be interpreted as indirect support for the framework rather than a direct validation of its theoretical processes.

6. Limitations

The following points are considered the major limitations of the current study. First, given that a correlational, cross-sectional methodological approach has been employed in this study, longitudinal and quasi-experimental designs are needed to establish causal pathways between teachers' AI integration practices and students' creative thinking development. A particularly promising avenue is to examine whether students' creative thinking functions as a mediator between AI-enhanced instruction and measurable academic outcomes, such as standardized achievement scores, problem-solving performance, and higher-order cognitive skills. Second, given that the sample of this study included only 30 purposive teacher participants, actual generalization of results to the entire teacher population in the UAE is limited. Therefore, future research should investigate the mechanisms through which AI-enhanced teaching contributes to broader educational outcomes. An additional limitation concerns the use of two newly developed measurement instru-

ments. Although both the Teachers' AI Application Use Questionnaire (TAAUQ) and the Students' Creative Thinking Questionnaire (SCTQ) demonstrated satisfactory psychometric properties, including expert-validated content, acceptable confirmatory factor analysis indices, high internal consistency, and test–retest reliability, they have not yet been externally validated against widely established measures. Finally, future investigations should also incorporate multiple sources of evidence, including classroom observations, AI learning analytics, teacher interviews, student portfolios, and objective performance-based creativity assessments (e.g., Torrance Tests of Creative Thinking), thereby reducing the limitations associated with self-reported data. Furthermore, researchers should explore the moderating effects of teacher AI competency, digital infrastructure, and student motivation on the AI–creativity relationship.

7. Conclusions

In summary, the present study makes a significant contribution to the current literature, as it provides new information to be utilized in future research and informs pedagogical practice. First, the study evidences the presence of a significant relationship (for the first time) between the Grade 8 teachers' use of AI applications and the students' creative thinking in the context of a GCC educational framework, thus establishing evidence of ($r = 0.54$, $p < 0.001$) and ($\Delta R^2 = 0.28$); therefore, the evidence collectively provides a meaningful increase in variance in students' creative outcomes when using AI applications compared to background factors. Second, the current study reveals that the students' creative outcomes are produced as a function of different dimensions of AI use, specifically those that correspond to the instructional delivery and assessment-and-feedback dimensions of AI use, whereas research has illustrated other dimensions (i.e., pedagogical planning and professional development) are not significant independent predictors of students' creative outcomes when controlled with other AI-use domains; thus, this finding challenges the assumption that any increased amount or use of AI will produce better creative outcomes for students. Third, the present findings provide preliminary empirical support for the ACIC framework. While the observed associations between AI-enhanced instructional delivery, assessment-and-feedback, and students' creative thinking are consistent with the theoretical propositions of the ACIC, the underlying mechanisms of cognitive offloading, generative scaffolding, and reflective amplification were not directly measured in the present study. Therefore, these mechanisms should be regarded as theoretically inferred rather than empirically verified. Although this study's findings were generally consistent with the ACIC's hierarchical structure of research predictions and support the assertion that AI applications utilize different processes for creativity development, the findings also indicate that including AI practices that relate to cognitive offloading (e.g., using AI to have a student complete an assignment based on pre-created materials) do not predict significant creative outcomes. Finally, a secondary finding of substantial theoretical importance is regarding the students' statistically and practically significant score on originality ($M = 3.31$) in comparison to their fluency ($M = 3.52$), flexibility ($M = 3.48$), and elaboration ($M = 3.49$). Because originality was defined as the production of statistically infrequent and/or original ideas (Kaufman & Sternberg, 2010), its significance should be interpreted to indicate that the AI-practice strategies currently employed in the AI-inclusive classrooms in Abu Dhabi do not currently support students' production of ongoing novel ideas. This pattern may serve as an initial indication that future research should explore whether AI applications emphasizing open-ended ideation and divergent-generative activities can further support the development of originality. Given the present study's descriptive-correlational design, these implications are best viewed as hypotheses for future investigation rather than definitive conclusions.

The new Theory of AI–Creativity Integration Continuum (ACIC) is the first theoretical model to provide a specific account of how teacher–student interactions lead to increased levels of creativity in students through the integration of AI into the classroom. It has also provided an initial empirical basis for testing the hypothesis of the ACIC. The model proposes three conceptual mechanisms that may help explain the observed associations between teachers’ AI integration practices and students’ creative thinking, providing a basis for future experimental and longitudinal investigations: (1) Cognitive Offloading (Freeing Working Memory for Higher Order Thinking), (2) Generative Scaffolding (Extending Ideational Repertoires via AI-Prompts), and (3) Reflective Amplification (Extending Students’ Metacognitive Originality through Comparing Their Work to AI). Each of these mechanisms relate directly to the various ways in which AI is used by instructors and allows researchers to empirically test the creativity outcomes associated with each type of integration. The findings from this study provide preliminary empirical support for the ACIC’s core hypothesis. Schools in both the ADEK and GCC have clear evidence to support investments in professional development focused on enhancing teachers’ competencies in two areas—AI-Enhanced Instructional Delivery and AI-Enhanced Formative Assessment—both of which are associated with increased creativity. On the other hand, across all GCC schools, implementing blanket policies regarding AI will not guarantee that students will be encouraged to be creative, which is one of the main outcomes of the national AI strategies.

Although this is the first study to provide evidence to support the ACIC, the data obtained are correlational, so any conclusions regarding cause-and-effect relationships must be established through an experimental follow-up study. Future studies are needed to conduct longitudinal studies to measure changes in creative thought over time, as AI integrations become more integrated into instructional practice, and to collect data using performance-based measures (e.g., Torrance Tests of Creative Thinking) rather than relying solely on surveys. Further research in other GCC and MENA countries will define the boundaries for the ACIC and will help determine if the creativity deficit observed in this study is a contextual issue or a common characteristic of the early stages of AI integrations across educational contexts. Finally, the hierarchical nature of the ACIC provides additional hypotheses to study with respect to the relationship between the depth of integration and the dimensions of creativity and offers an excellent opportunity for future studies using both experimental and quasi-experimental methodologies.

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Abbreviations

The following abbreviations are used in this manuscript:

UAE	United Arab Emirates
ADEK	Abu Dhabi Department of Education and Knowledge
ACIC	AI–Creativity Integration Continuum
GCC	Gulf Cooperation Council
CFA	Confirmatory Factor Analysis

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