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The Use of Generative Artificial Intelligence, Creative Thinking, And Perceived Academic Achievement Among Vocational Education Students in Jordanian Universities: A Descriptive Correlational Study

استخدام الذكاء الاصطناعي التوليدي والتفكير الإبداعي والتحصيل الأكاديمي المدرك لدى طلبة التربية المهنية بالجامعات الأردنية: دراسة وصفية ارتباطية

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A B S T R A C T

This study examined the relationship between the use of generative artificial intelligence (GenAI), creative thinking, and perceived academic achievement among vocational education and public safety students at Jordanian universities, and tested whether the study variables differed by gender. A quantitative, cross-sectional, descriptive-correlational design was used. The sample comprised 140 undergraduate students selected through convenience sampling from Al-Balqa Applied University, Jadara University, Irbid National University, Jerash University, and Aqaba University of Technology. Students from Jerash University and Aqaba University of Technology were enrolled in vocational education and public safety programs. A 40-item questionnaire measured three dimensions of GenAI use and five educational outcomes: fluency, flexibility, originality, problem sensitivity, and perceived academic achievement. Overall GenAI use was high ($M = 3.96$, $SD = 0.59$). Fluency, flexibility, problem sensitivity, and perceived academic achievement were high, while originality was medium and recorded the lowest mean ($M = 3.43$, $SD = 0.68$). GenAI use was positively and moderately correlated with the combined creative-thinking and achievement outcome ($r = .56$, $p < .001$). No statistically significant gender differences were found, and all effect sizes were very small. The study concludes that GenAI can support idea generation, applied problem solving, lesson and activity planning, risk analysis, professional communication, and academic learning when its use is guided by independent thinking, technical verification, transparent disclosure, and authentic assessment. Jordanian universities are encouraged to embed responsible GenAI literacy in vocational education and public safety programs while protecting originality and practical competence.

الملخص

هدفت هذه الدراسة إلى فحص العلاقة بين استخدام الذكاء الاصطناعي التوليدي والتفكير الإبداعي والتحصيل الأكاديمي المدرك لدى طلبة التربية المهنية والسلامة العامة في الجامعات الأردنية، واختبار الفروق في متغيرات الدراسة تبعاً للجنس. اعتمدت الدراسة المنهج الكمي الوصفي الارتباطي المقطعي، وتكونت العينة من (140) طالباً وطالبة من طلبة البكالوريوس، اختيروا بالطريقة المتاحة من جامعة

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البلقاء التطبيقية، وجامعة جدارا، وجامعة إربد الأهلية، وجامعة جرش، وجامعة العقبة للتكنولوجيا. وشملت العينة في جامعتي جرش والعقبة للتكنولوجيا طلبة من برنامجي التربية المهنية والسلامة العامة. واستخدمت استبانة مكونة من (40) فقرة لقياس ثلاثة أبعاد لاستخدام الذكاء الاصطناعي التوليدي، وخمسة نواتج تعليمية هي: الطلاقة، والمرونة، والأصالة، والحساسية للمشكلات، والتحصيل الأكاديمي المدرك. أظهرت النتائج أن مستوى الاستخدام الكلي للذكاء الاصطناعي التوليدي كان مرتفعاً (المتوسط = 3.96، والانحراف المعياري = 0.59). كما جاءت الطلاقة والمرونة والحساسية للمشكلات والتحصيل الأكاديمي المدرك بمستوى مرتفع، في حين جاءت الأصالة بمستوى متوسط وسجلت أدنى متوسط (3.43، والانحراف المعياري = 0.68). وظهرت علاقة ارتباطية موجبة متوسطة ودالة إحصائياً بين استخدام الذكاء الاصطناعي التوليدي والناتج المركب للتفكير الإبداعي والتحصيل الأكاديمي المدرك (r = .56، p < .001). ولم تظهر فروق دالة إحصائياً تبعاً للجنس، وكانت أحجام الأثر صغيرة جداً. وتخلص الدراسة إلى أن الذكاء الاصطناعي التوليدي يمكن أن يدعم توليد الأفكار، وحل المشكلات التطبيقية، وتخطيط الدروس والأنشطة، وتحليل المخاطر، والتواصل المهني، والتعلم الأكاديمي، شريطة أن يقترن بالتفكير المستقل والتحقق الفني والإفصاح الشفاف والتقويم الأصيل. وتوصي الدراسة بإدماج محو الأمية المسؤول في الذكاء الاصطناعي التوليدي ضمن برامج التربية المهنية والسلامة العامة في الجامعات الأردنية، مع حماية الأصالة والكفاية العملية.

الكلمات المفتاحية:

الذكاء الاصطناعي التوليدي؛ التفكير الإبداعي؛ التحصيل الأكاديمي المتصور؛ التعليم المهني؛ السلامة العامة؛ الجامعات الأردنية.

JEL Classification: *I21, I23, O33, C83.*

1. Introduction

Generative artificial intelligence (GenAI) has moved rapidly from a specialist technology to a widely accessible learning resource capable of producing explanations, examples, summaries, code, feedback, and extended academic prose in response to natural-language prompts. This shift differs from earlier educational technologies because GenAI does not merely retrieve stored content; it generates context-sensitive outputs that can be revised through dialogue. In higher education, this capability has created opportunities for personalized support, rapid formative feedback, multilingual assistance, brainstorming, and writing development (Adiguzel et al., 2023; Kasneci et al., 2023; Su & Yang, 2023). At the same time, GenAI can produce inaccurate information, invented references, biased responses, and fluent but shallow explanations, requiring users to exercise source evaluation, disciplinary judgment, and ethical responsibility (Bender et al., 2021; Farrokhnia et al., 2024; UNESCO, 2023). The educational value of GenAI is therefore not determined by access alone. It depends on how students frame questions, inspect evidence, compare alternatives, revise outputs, and preserve ownership of the intellectual process. Research on students' perceptions shows that learners value GenAI for brainstorming, explanation, and writing support, but also express concerns about reliability, privacy, overdependence, and effects on personal development (Chan & Hu, 2023). Institutional guidance increasingly emphasizes human oversight, transparency, privacy, alignment with learning objectives, and assessment designs that make the student's reasoning visible (OECD, 2023; U.S. Department of Education, 2023; UNESCO, 2023).

Creative thinking is especially important in this debate. Creativity in education involves generating multiple ideas, shifting between perspectives, producing uncommon or original responses, and recognizing problems that deserve investigation. These qualities are commonly represented through fluency, flexibility, originality, and problem sensitivity, building on the traditions of Guilford (1967) and Torrance (1974). Contemporary creativity theory further stresses that creative performance is situated, developmental, and responsive to tools, social interaction, domain knowledge, and motivation (Amabile, 1996; Beghetto & Kaufman, 2007; Sawyer, 2012). GenAI may strengthen creative activity by lowering the cost of idea generation and exposing learners to alternatives; however, it may also anchor users to conventional patterns or reduce the diversity of outputs when many learners depend on similar machine-generated suggestions

(Doshi & Hauser, 2024; Koivisto & Grassini, 2023). Academic achievement is also likely to be affected through several mechanisms. GenAI can clarify difficult concepts, provide examples, support self-paced practice, and offer immediate feedback, all of which may improve perceived competence and engagement. Experimental evidence outside formal education has shown that GenAI can increase the speed and quality of some writing tasks, especially for less experienced performers (Noy & Zhang, 2023). In educational settings, positive effects have been reported for computational thinking, programming self-efficacy, and motivation when the technology is incorporated into structured learning activities (Yilmaz & Yilmaz, 2023). Nevertheless, performance gains are not equivalent to durable learning. Students may produce better-looking work without developing the underlying knowledge if the tool replaces rather than stimulates cognitive effort (Cotton et al., 2024; Perkins, 2023).

Most early research has been conducted in technologically advanced or English-dominant contexts, while evidence from Jordanian and wider Arab higher education remains limited. The gap is particularly visible in vocational education, where students must integrate educational theory with applied problem solving, lesson and activity design, occupational knowledge, workshop practice, and preparation for changing workplaces. Differences in infrastructure, Arabic-language resources, faculty guidance, assessment traditions, and digital literacy may shape both the use and educational consequences of GenAI. Furthermore, few studies have examined creative-thinking dimensions and perceived academic achievement within a single model among vocational education students. Addressing this gap, the present study investigates GenAI use among vocational education students at Jordanian universities and examines its association with creative thinking and perceived academic achievement.

1.1. Problem Statement

The central problem is that vocational education students are adopting GenAI faster than universities can establish pedagogically grounded practices for its use in applied and professional learning. The same tool can function as a tutor, brainstorming partner, lesson-planning assistant, technical explainer, editor, or shortcut. Consequently, high usage does not necessarily imply stronger professional competence, and improved written output does not necessarily indicate stronger creativity or practical understanding. The problem is particularly important for originality and technical accuracy: GenAI can expand the number of ideas and proposed solutions while also encouraging convergence toward common patterns or producing unsafe, inaccurate, or context-insensitive instructions. Evidence is therefore needed to determine whether vocational education students who report greater GenAI use also report stronger creative-thinking capabilities and perceived academic achievement, and whether these outcomes differ by gender.

1.2. Study Objectives

- Determine the level of GenAI use among vocational education students at Jordanian universities in relation to frequency, brainstorming and idea generation, and academic-writing and vocational-task support.
- Assess students' levels of fluency, flexibility, originality, problem sensitivity, and perceived academic achievement.
- Examine the association between GenAI use and the combined outcome of creative thinking and perceived academic achievement.
- Test whether the study variables differ according to gender.
- Develop evidence-based recommendations for responsible pedagogical integration of GenAI in vocational education programs at Jordanian universities.

1.3. Research Questions

- What is the reported level of GenAI use among vocational education students at Jordanian universities?
- What are the reported levels of creative-thinking dimensions and perceived academic achievement?
- Is GenAI use significantly associated with creative thinking and perceived academic achievement?
- Do the study variables differ significantly according to gender?

1.4. Research Hypotheses

- H1: GenAI use is positively and significantly associated with creative thinking and perceived academic achievement among vocational education students.
- H2: There are no statistically significant gender differences in the study variables.

1.5. Significance of the Study

The study contributes empirically and practically. Empirically, it adds evidence from Jordanian applied higher education to a literature dominated by studies from other regions and general university populations. Conceptually, it treats creative thinking as multidimensional rather than reducing it to a general attitude toward AI. Practically, it distinguishes productive use—such as generating alternatives, planning lessons and professional activities, explaining technical or safety concepts, and revising solutions—from substitutional use in which students delegate the central intellectual or practical reasoning to the system. The findings can inform curriculum design, faculty development, field-training preparation, academic-integrity policy, authentic assessment, and professional human development in vocational education and public safety programs.

2. Literature Review

2.1. Generative Artificial Intelligence in Higher Education

Artificial intelligence in higher education predates current large language models and includes intelligent tutoring, adaptive systems, automated feedback, prediction, and administrative decision support. Reviews of the field have documented growing use of AI for learner support and institutional functions while also noting limited educator involvement and insufficient attention to pedagogy and ethics (Chen et al., 2020; Crompton & Burke, 2023; Zawacki-Richter et al., 2019). GenAI extends this trajectory by enabling open-ended language interaction and content generation at unprecedented scale. Large language models generate text by estimating probable linguistic sequences from patterns learned during training. Their fluency can create an impression of understanding even when the output contains factual or logical errors. For education, the consequence is a dual requirement: learners need operational competence in prompting and revision, but they also need epistemic competence to verify claims, identify uncertainty, and compare generated content with authoritative sources (Kasneci et al., 2023; Rahman & Watanobe, 2023). The complementary model proposed by Jeon and Lee (2023) is therefore more defensible than a replacement model: teachers contribute contextual judgment, ethical responsibility, relational support, and curricular purpose, whereas GenAI contributes speed, variation, and conversational availability. Student adoption is influenced by perceived usefulness, accessibility, disciplinary relevance, and institutional rules. Chan and Hu (2023) found that students recognized benefits for personalized learning, writing, brainstorming, research, and analysis, alongside concerns about accuracy, privacy, ethics, and future development. Strzelecki (2025) similarly showed that expectations and acceptance are shaped by the perceived value of the tool. These findings suggest that universities should not assume uniform use; the same platform may be used for explanation in one discipline, programming assistance in another, and language editing in a third.

2.2. Creative Thinking as a Multidimensional Educational Outcome

Creative thinking is the capacity to generate ideas or solutions that are both novel and appropriate to a task. Divergent thinking is not identical to creativity, but it is a widely used indicator of creative potential because it captures the production of multiple and varied possibilities (Runco & Acar, 2012). Fluency refers to the number of relevant ideas; flexibility refers to movement across categories or perspectives; originality concerns uncommon or distinctive responses; and problem sensitivity concerns noticing gaps, contradictions, or opportunities for inquiry. These dimensions are rooted in Guilford's structure-of-intellect tradition and Torrance's assessment work (Guilford, 1967; Torrance, 1974). Contemporary models place these cognitive dimensions within a social and developmental context. Amabile (1996) emphasizes the interaction of domain-relevant knowledge, creativity-relevant processes, and motivation. The mini-c perspective highlights personally meaningful interpretations that emerge during learning, not only eminent products recognized by society (Beghetto & Kaufman, 2007). The Four-C model similarly distinguishes mini-c, little-c, Pro-c, and Big-C creativity, enabling educators to recognize developmental progress in ordinary coursework (Kaufman & Beghetto, 2009). Consequently, a technology supports creativity only when it increases learners' meaningful agency, experimentation, and evaluation rather than merely increasing the quantity of text produced.

2.3. How GenAI May Support Creative Thinking

GenAI can support fluency by producing examples, questions, analogies, and alternative starting points quickly. It can support flexibility by reframing a problem through different stakeholder, disciplinary, temporal, or cultural perspectives. It can also reduce blank-page anxiety and provide a conversational environment in which students can refine vague ideas. The IDEE framework proposed by Su and Yang (2023) emphasizes identifying intended outcomes, determining an appropriate level of automation, ensuring ethical use, and evaluating effectiveness. Applied to creativity, this means that prompting should be linked to a clear creative objective and followed by human selection, transformation, and justification. Evidence from creative tasks supports a qualified benefit. Koivisto and Grassini (2023) found that AI chatbots performed strongly on an alternate-uses task and outperformed average human responses, although the best human ideas remained competitive. Doshi and Hauser (2024) found that access to GenAI ideas improved evaluations of individual stories, particularly for less creative writers, but reduced collective diversity because assisted stories became more similar to one another. Together, these studies indicate that GenAI may raise the floor of creative performance while creating a convergence risk. This makes originality a critical dimension for educational evaluation. Productive co-creativity requires students to modify rather than merely select AI suggestions. Suitable strategies include generating ideas independently before consulting AI, asking the system for contrasting or deliberately unusual perspectives, combining ideas from multiple sources, documenting revisions, and explaining why the final response is preferable. Such practices preserve student authorship and align technology use with the constructive-alignment principle that learning activities and assessment should directly serve intended outcomes (Biggs & Tang, 2011).

2.4. Risks to Originality, Critical Engagement, and Academic Integrity

The main risk is cognitive substitution. When students use GenAI to perform the very process that an assignment is intended to develop, the final product may conceal limited learning. Fluent output can also discourage scrutiny because it appears coherent and authoritative. Farrokhnia et al. (2024) identify lack of deep understanding, difficulty evaluating response quality, bias, academic-integrity threats, and possible decline in higher-order thinking as central weaknesses and threats. UNESCO (2023) similarly calls for a human-centered approach that protects agency, inclusion, privacy, and cultural and linguistic diversity. Academic integrity cannot be addressed solely through detection. GenAI-generated text can be difficult to distinguish from human writing, and punitive reliance on uncertain detection risks unfairness. Perkins (2023) argues that acceptable use depends on institutional policy and transparent disclosure, while Cotton et al. (2024) recommend revised policies, training, and diversified assessment. Rudolph et al. (2023) contend that the emergence of ChatGPT requires fundamental reconsideration of traditional assessment. Process evidence (such as proposals, drafts, oral defences, version histories, reflective commentaries, and source checks) is therefore more educationally meaningful than an exclusive focus on identifying machine-generated language. A further challenge concerns linguistic and cultural representation. Large models may provide strong support to students writing in a second language, but they may also normalize dominant styles and marginalize local expression. Kohnke et al. (2023) emphasize that ethical and effective language-learning use requires digital competencies. In Arabic-speaking contexts, students must be encouraged to examine terminology, translation quality, cultural assumptions, and the accuracy of generated references rather than treating polished language as proof of validity.

2.5. GenAI and Perceived Academic Achievement

Academic achievement reflects performance in learning tasks, but perceived academic achievement specifically captures students' judgments about their understanding, efficiency, confidence, and progress. Self-perceptions can influence motivation and self-regulated learning, although they should not be treated as a substitute for objective grades or performance measures. Research on university achievement shows that motivational and self-regulatory factors are important alongside prior attainment and cognitive ability (Pintrich, 2004; Richardson et al., 2012; Zimmerman, 2002). GenAI may improve perceived achievement by offering immediate clarification, examples, feedback, and planning assistance. It can help students decompose complex tasks and monitor understanding, thereby supporting self-regulation. Yilmaz and Yilmaz (2023) reported positive effects of a GenAI-based tool on computational thinking, programming self-efficacy, and motivation in a structured educational context. Noy and Zhang (2023) found productivity and quality gains in professional writing tasks, suggesting that assistive use can improve output and reduce performance gaps. However, these gains depend on task design and learner engagement. Hattie's (2009) synthesis underscores the value of feedback when it helps learners understand where they are, where they need to go, and what actions should follow; automated output without reflection does not automatically meet this standard. Perceived achievement may also be inflated if students equate task completion with learning. This is particularly likely when GenAI supplies finished answers. Accordingly, studies should distinguish support for learning from support for performance and should complement self-report with objective indicators, delayed tests, or authentic products in future research.

2.6. Vocational Education Context and Gender Differences

Vocational education connects pedagogical understanding with applied, technical, and occupational competence. GenAI can assist students in generating lesson plans, designing competency-based activities, constructing workplace scenarios, explaining technical concepts, producing differentiated learning materials, and exploring alternative solutions to practical problems. Its value is greatest when generated suggestions are checked against curriculum standards, verified technical sources, workshop safety requirements, and the realities of local workplaces. Because practical competence develops through performance, observation, feedback, and repeated hands-on experience, GenAI should complement rather than replace field training, workshop practice, and professional judgment (Biggs & Tang, 2011; OECD, 2023; UNESCO, 2023). The literature does not support a simple expectation of universal gender differences in creativity or technology use. Baer and Kaufman (2008) conclude that gender differences in creativity depend on domain, developmental stage, social expectations, and measurement. Within vocational education, access to digital tools, prior technical experience, perceived usefulness, and the learning environment may matter more than gender alone. The absence of gender differences can therefore indicate broadly comparable opportunities to use GenAI, although this interpretation should be tested with larger, balanced, and multi-university samples.

2.7. Theoretical Framework and Expected Relationships

The study is informed by a human–AI scaffolding perspective that integrates constructivist learning, self-regulation, co-creativity, and applied professional learning. GenAI provides temporary cognitive support by offering prompts, alternatives, examples, scenarios, and feedback. Vocational education students remain responsible for defining the problem, checking technical and pedagogical accuracy, judging relevance to learners and workplaces, transforming suggestions, testing feasibility, and reflecting on outcomes. When this cycle is active, GenAI use should be positively associated with fluency, flexibility, problem sensitivity, and perceived achievement. Originality may improve less strongly because common model outputs can create anchoring and convergence. Universal gender differences are not necessarily expected.

TABLE I. STUDY CONSTRUCTS AND OPERATIONAL DIMENSIONS

Construct	Dimensions	Operational focus
GenAI use	Frequency of use; brainstorming and idea generation; academic-writing and vocational-task support	Extent and purpose of vocational education students' engagement with generative AI tools.
Creative thinking	Fluency; flexibility; originality; problem sensitivity	Self-reported capacity to generate, vary, distinguish, and identify ideas or problems.
Perceived academic achievement	Understanding, task completion, confidence, efficiency, academic progress, and support for professional learning	Students' judgments of academic improvement rather than verified GPA or test performance.
Grouping variable	Gender	Comparison of reported levels between male and female vocational education students.

3. Methodology

3.1. Research Design

The study adopted a quantitative, cross-sectional, descriptive-correlational design. The design was appropriate because the study sought to describe the levels of GenAI use, creative thinking, and perceived academic achievement, examine the relationships among these variables, and test gender differences without manipulating the learning environment. The cross-sectional approach enabled data to be collected from students at one point during the study period. Because the study was correlational, the results indicate statistical associations and should not be interpreted as evidence that GenAI use caused changes in creativity or academic achievement.

3.2. Population and Sample

The target population consisted of undergraduate students enrolled in vocational education and related applied programs at Jordanian universities. The study was conducted at five institutions: Al-Balqa Applied University, Jadara University, Irbid National University, Jerash University, and Aqaba University of Technology. Participants from Al-Balqa Applied University, Jadara University, and Irbid National University were enrolled in vocational education programs. The participating students from Jerash University and Aqaba University of Technology were drawn from vocational education and public safety programs. This multi-institutional coverage introduced variation in institutional settings and applied academic experiences. The final sample comprised 140 male and female undergraduate students selected through convenience sampling. Eligible participants had prior experience with, or sufficient awareness of, generative artificial intelligence tools in academic, vocational, or public-safety contexts. Convenience sampling was used because it facilitated access to students in the participating programs during the data-collection period. Although the inclusion of five universities increased the diversity of the sample, the non-probability sampling method limits the extent to which the findings can be generalized to all vocational education and public safety students in Jordan.

3.3. Research Instrument

Data were collected using a 40-item self-report questionnaire. The instrument was organized into two broad fields. The first field measured GenAI use through three dimensions: frequency of use, brainstorming and idea generation, and academic-writing and applied-task support. The second field measured five educational outcomes: fluency, flexibility, originality, problem sensitivity, and perceived academic achievement. Items addressed the use of GenAI for understanding course content, generating and comparing ideas, organizing written work, preparing lesson plans and professional materials, addressing vocational tasks, exploring risk or safety scenarios, and supporting academic progress. Responses were recorded on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicated greater GenAI use or a stronger perceived level of the corresponding educational outcome. Dimension scores were calculated by averaging the relevant item responses, and an overall GenAI-use score and an overall creative-thinking score were calculated for the inferential analyses. The combined outcome used in hypothesis testing integrated the creative-thinking and perceived-achievement scores.

3.4. Validity and Reliability

The content of the questionnaire was aligned with the operational definitions and dimensions derived from the literature on GenAI use, divergent and creative thinking, self-regulated learning, and perceived academic achievement. Items were formulated to reflect the applied contexts of vocational education and public safety and were checked for clarity, relevance, and consistency with the study objectives before distribution. Internal consistency was evaluated using Cronbach's alpha for every dimension, the overall scales, and the complete questionnaire. The reliability coefficients ranged from .81 to .96, exceeding the commonly accepted minimum of .70. The coefficients were .84 for frequency of GenAI use, .87 for brainstorming and idea generation, .89 for academic-writing and applied-task support, and .93 for overall GenAI use. For the outcomes, alpha was .85 for fluency, .83 for flexibility, .81 for originality, .84 for problem sensitivity, .92 for overall creative thinking, and .90 for perceived academic achievement. The total questionnaire produced an alpha coefficient of .96, indicating excellent overall internal consistency.

TABLE II. INTERNAL-CONSISTENCY COEFFICIENTS FOR THE STUDY SCALES

Scale or dimension	Cronbach's alpha
Frequency of GenAI use	.84
Brainstorming and idea generation	.87
Academic-writing and applied-task support	.89
Overall GenAI use	.93
Fluency	.85
Flexibility	.83
Originality	.81
Problem sensitivity	.84
Overall creative thinking	.92

Perceived academic achievement	.90
Total questionnaire	.96

3.5. Data Collection Procedures and Ethical Considerations

The questionnaire was distributed to undergraduate students at Al-Balqa Applied University, Jadara University, Irbid National University, Jerash University, and Aqaba University of Technology. At Jerash University and Aqaba University of Technology, the participants included students enrolled in vocational education and public safety programs. Data collection was conducted after obtaining the necessary institutional permissions and explaining the purpose of the study to potential participants. Students were informed that participation was voluntary, that they could decline participation without academic consequences, and that their responses would be treated confidentially and used only for research purposes. The questionnaire did not require directly identifying personal information. All 140 completed questionnaires were retained for analysis.

3.6. Data Analysis

Data screening was conducted before hypothesis testing. The dataset was examined for missing values, outliers, and the distribution of the main variables. The absolute skewness and kurtosis values were below 1.00, indicating no serious departure from normality. Descriptive statistics included frequencies, percentages, means, standard deviations, and ranks. Means were interpreted using the following criteria for the five-point scale: 1.00-2.33 = low, 2.34-3.67 = medium, and 3.68-5.00 = high.

Cronbach's alpha was used to assess internal consistency. Pearson's product-moment correlation coefficient was used to examine the relationships between overall GenAI use and the outcome variables. Independent-samples t tests were used to examine gender differences, and Cohen's d was reported to evaluate practical magnitude. Correlations were interpreted according to their direction and magnitude, while statistical significance was evaluated at alpha = .05. Ninety-five percent confidence intervals were reported for the correlation coefficients.

4. Results

4.1. Preliminary Data Analysis

The analysis included 140 valid responses. No questionnaire was excluded from the final dataset. Screening indicated that the main variables had absolute skewness and kurtosis values below 1.00, supporting the use of Pearson's correlation and independent-samples t tests. Cronbach's alpha coefficients ranged from .81 to .96, demonstrating satisfactory to excellent internal consistency for all scales and dimensions.

4.2. Characteristics of the Participants

The participants were recruited from five Jordanian universities and represented vocational education and public safety programs. Table 3 identifies the participating institutions and programs. Because institution-specific frequencies were not included in the available statistical summary, the table reports program coverage without assigning unverified counts to individual universities.

TABLE III. PARTICIPATING UNIVERSITIES AND ACADEMIC PROGRAMS

University	Academic program represented
Al-Balqa Applied University	Vocational Education
Jadara University	Vocational Education
Irbid National University	Vocational Education
Jerash University	Vocational Education and Public Safety
Aqaba University of Technology	Vocational Education and Public Safety

The sample consisted of 64 male students (45.7%) and 76 female students (54.3%). Both groups were adequately represented for the planned gender comparisons, although female students formed a slightly larger proportion of the sample.

TABLE IV. DISTRIBUTION OF PARTICIPANTS ACCORDING TO GENDER

Gender	Frequency	Percentage
Male	64	45.7%
Female	76	54.3%
Total	140	100.0%

4.3. Level of Generative Artificial Intelligence Use

The first research question examined the reported level of GenAI use among vocational education and public safety students at Jordanian universities. Means and standard deviations were calculated for the three dimensions and the overall scale. Table 5 shows that overall GenAI use was high (M = 3.96, SD = 0.59). All three dimensions were also classified at the high level.

TABLE V. MEANS AND STANDARD DEVIATIONS FOR GENAI USE

Rank	Dimension	Mean	SD	Level
1	Brainstorming and idea generation	4.12	0.63	High
2	Frequency of use	3.97	0.68	High
3	Academic-writing and applied-task support	3.81	0.70	High
-	Overall GenAI use	3.96	0.59	High

Brainstorming and idea generation ranked first (M = 4.12, SD = 0.63), indicating that students frequently used GenAI to produce alternatives, initiate assignments, develop instructional or professional activities, and explore different approaches to vocational and safety-related problems. Frequency of use ranked second (M = 3.97, SD = 0.68), showing that GenAI had become a regular component of students' academic practices. Academic-writing and applied-task support ranked third but remained high (M = 3.81, SD = 0.70). This dimension included organizing written work, improving explanations, preparing plans and materials, summarizing information, and supporting applied vocational or public-safety tasks. The pattern demonstrates that GenAI was integrated into multiple learning activities rather than used only experimentally.

4.4. Levels of Creative Thinking and Perceived Academic Achievement

The second research question examined the reported levels of the creative-thinking dimensions and perceived academic achievement. Table 6 indicates medium-to-high outcomes. Fluency achieved the highest mean (M = 3.79, SD = 0.61), followed by perceived academic achievement (M = 3.77, SD = 0.65), problem sensitivity (M = 3.72, SD = 0.62), and flexibility (M = 3.70, SD = 0.64). All four were classified as high.

TABLE VI. MEANS AND STANDARD DEVIATIONS FOR CREATIVE THINKING AND PERCEIVED ACADEMIC ACHIEVEMENT

Rank	Outcome dimension	Mean	SD	Level
1	Fluency	3.79	0.61	High
2	Perceived academic achievement	3.77	0.65	High
3	Problem sensitivity	3.72	0.62	High
4	Flexibility	3.70	0.64	High
5	Originality	3.43	0.68	Medium
-	Overall creative thinking	3.66	0.57	Medium

Originality recorded the lowest mean (M = 3.43, SD = 0.68) and was the only creative-thinking dimension classified at the medium level. This indicates that students perceived GenAI as more effective for increasing the number and variety of ideas and for identifying problems than for ensuring that their final ideas were unusual or distinctive. Overall creative thinking was also medium (M = 3.66, SD = 0.57), whereas perceived academic achievement was high. Students therefore generally believed that GenAI supported understanding, confidence, efficiency, academic progress, and task completion, while the development of originality remained comparatively limited.

4.5. Relationship between GenAI Use, Creative Thinking, and Perceived Academic Achievement

The third research question examined whether GenAI use was significantly associated with creative thinking and perceived academic achievement. Pearson's correlation coefficients are presented in Table 7. GenAI use was positively and significantly associated with every outcome. The association with the combined creative-thinking and achievement outcome was moderate and statistically significant ($r = .56$, 95% CI [.43, .66], $p < .001$).

TABLE VII. CORRELATIONS BETWEEN GENAI USE AND THE STUDY OUTCOMES

Outcome variable	r	95% CI	p	Magnitude
Fluency	.49	[.35, .61]	< .001	Moderate
Flexibility	.45	[.31, .57]	< .001	Moderate

Originality	.32	[.16, .46]	< .001	Low to moderate
Problem sensitivity	.47	[.33, .59]	< .001	Moderate
Overall creative thinking	.51	[.38, .62]	< .001	Moderate
Perceived academic achievement	.55	[.42, .66]	< .001	Moderate
Combined outcome	.56	[.43, .66]	< .001	Moderate

The strongest individual association was observed between GenAI use and perceived academic achievement ($r = .55$, $p < .001$), followed by overall creative thinking ($r = .51$, $p < .001$). The weakest relationship was with originality ($r = .32$, $p < .001$), although it remained statistically significant. These results support H1 and indicate that students who used GenAI more extensively tended to report stronger academic confidence and progress, greater idea fluency and flexibility, and better problem recognition. The findings remain correlational and do not establish causal influence.

4.6. Gender Differences in the Study Variables

The fourth research question examined whether the study variables differed according to gender. Independent-samples t tests showed no statistically significant differences between male and female students for overall GenAI use, the creative-thinking dimensions, overall creative thinking, perceived academic achievement, or the combined outcome. All p values exceeded .05.

TABLE VIII. INDEPENDENT-SAMPLES T TESTS FOR GENDER DIFFERENCES

Variable	Male M (SD)	Female M (SD)	t	p	Cohen's d
Overall GenAI use	3.92 (0.61)	3.99 (0.58)	-0.69	.490	-0.12
Fluency	3.75 (0.63)	3.82 (0.59)	-0.67	.501	-0.12
Flexibility	3.67 (0.66)	3.73 (0.62)	-0.55	.583	-0.09
Originality	3.39 (0.70)	3.46 (0.66)	-0.60	.546	-0.10
Problem sensitivity	3.69 (0.64)	3.75 (0.60)	-0.57	.571	-0.10
Overall creative thinking	3.63 (0.59)	3.68 (0.55)	-0.52	.607	-0.09
Perceived academic achievement	3.73 (0.68)	3.81 (0.62)	-0.72	.472	-0.12
Combined outcome	3.68 (0.57)	3.74 (0.53)	-0.64	.523	-0.11

Female students obtained slightly higher means on several variables, but the effect sizes were very small, with absolute Cohen's d values ranging from 0.09 to 0.12. The differences were therefore neither statistically significant nor practically substantial. H2 was supported: within the limitations of the sample, male and female students reported broadly comparable levels of GenAI use, creative thinking, and perceived academic achievement.

4.7. Summary of Hypothesis Testing

TABLE IX. SUMMARY OF THE STUDY HYPOTHESES

Hypothesis	Statistical result	Decision
H1: GenAI use is positively and significantly associated with creative thinking and perceived academic achievement.	Combined outcome: $r = .56$, $p < .001$	Supported
H2: There are no statistically significant gender differences in the study variables.	All p values > .05; effect sizes very small	Supported

The results demonstrated high use of GenAI, medium-to-high educational outcomes, a moderate positive relationship between GenAI use and the combined outcome, and no statistically significant gender differences.

5. Discussion

5.1. Level and Purposes of GenAI Use

The study found a high overall level of GenAI use among vocational education and public safety students at Jordanian universities. Brainstorming and idea generation ranked first, followed by frequency of use and academic-writing and applied-task support. This pattern indicates that students viewed GenAI not merely as a text-production tool but as an interactive source of ideas, explanations, alternatives, and preliminary solutions. The high level of use is consistent with the rapid adoption of GenAI in higher education described by Adiguzel et al. (2023), Kasneci et al. (2023), and Lo (2023). These studies noted that the accessibility and conversational nature of GenAI allow students to obtain immediate explanations, generate examples, summarize materials, and receive support at different stages of academic work. The finding also agrees with Chan and Hu (2023), who reported that university students valued GenAI for personalized learning, writing, brainstorming, research, and analysis. Brainstorming obtained the highest mean, which can be explained by the open-ended and applied nature of vocational education and public safety tasks. Students may be required to prepare lesson plans, create workplace or emergency scenarios, design instructional and awareness activities, solve practical problems, identify hazards, plan preventive measures, or adapt materials to different learners and professional contexts. GenAI can rapidly suggest multiple objectives, examples, teaching approaches, risk scenarios, or possible solutions, thereby reducing the difficulty of starting a complex task. This interpretation is compatible with the IDEE framework proposed by Su and Yang (2023), in which GenAI is used purposefully according to intended educational outcomes and an appropriate level of automation. It also supports the complementary relationship described by Jeon and Lee (2023): GenAI contributes speed, variation, and availability, whereas students and instructors remain responsible for contextual judgment, practical feasibility, safety, ethics, and curricular or professional alignment. Academic-writing and applied-task support received the lowest mean among the GenAI-use dimensions, although it remained high. This relative reduction may reflect awareness that generated academic, technical, or safety information cannot always be accepted without verification. Applied tasks may involve technical standards, workshop procedures, emergency protocols, specialized terminology, or local workplace and public-safety requirements. Kasneci et al. (2023), Rahman and Watanobe (2023), and UNESCO (2023) similarly emphasized that GenAI can produce inaccuracies, fabricated references, bias, or contextually unsuitable recommendations. High use is educationally valuable only when students verify information against authoritative academic, technical, and regulatory sources.

5.2. Creative-Thinking Dimensions

Fluency, flexibility, and problem sensitivity were high, whereas originality was medium and obtained the lowest mean. This differentiated pattern is important because it shows that GenAI may support some components of creative thinking more readily than others. The high level of fluency suggests that students perceived themselves as capable of generating numerous ideas, examples, and possible solutions. GenAI is particularly suited to supporting fluency because it can produce multiple alternatives within a short period. This finding is consistent with Koivisto and Grassini (2023), who found that AI chatbots performed strongly in a divergent-thinking task involving alternative uses. The high level of flexibility indicates that students perceived GenAI as useful for considering a problem from different perspectives. A vocational education student can request alternative instructional approaches or adaptations for different learner needs, while a public safety student can compare preventive, procedural, organizational, and community-based responses to a risk scenario. This movement between categories and viewpoints is central to flexible thinking. Problem sensitivity was also high. GenAI may help students detect missing information, anticipate implementation barriers, identify hazards, reveal weaknesses in a proposed plan, or generate questions for further investigation. However, the learner must judge whether the identified issues are technically, pedagogically, legally, and contextually valid. GenAI can suggest potential problems, but professional judgment remains necessary to evaluate their seriousness and relevance. Originality recorded a medium level and the weakest correlation with GenAI use. This suggests that producing more ideas and considering more perspectives does not necessarily ensure that the final ideas are unusual or distinctive. GenAI systems generate outputs from patterns in existing data and may therefore offer coherent but conventional suggestions. The result agrees with Doshi and Hauser (2024), who found that GenAI improved evaluations of individual creative products while reducing collective diversity because assisted outputs became more similar. It also corresponds with Koivisto and Grassini (2023), who found that the strongest human responses remained highly competitive in originality. The lower originality result may also reflect cognitive anchoring. Once a student receives a polished machine-generated response, the student may revise it only superficially rather than developing an independent alternative. Farrokhnia et al. (2024) warned that overdependence can weaken deep engagement and higher-order thinking, while UNESCO (2023) emphasized preserving human agency. GenAI is not inherently harmful to originality, but its use should be structured. Students should generate initial ideas independently, request contrasting or deliberately unconventional alternatives, compare outputs with local evidence, and explain how the final response was transformed and justified.

5.3. Perceived Academic Achievement

Perceived academic achievement was high. Students generally believed that GenAI supported their understanding, confidence, efficiency, task completion, and academic progress. This finding is consistent with Yilmaz and Yilmaz (2023), who reported positive effects of structured GenAI use on computational thinking, self-efficacy, and motivation, and with Noy and Zhang (2023), who found improvements in speed and quality for professional writing tasks. Several mechanisms may explain this result. GenAI can provide immediate explanations, simplify complex concepts, generate examples, organize ideas, and help students divide a difficult assignment into manageable stages. These functions can reduce uncertainty and support confidence. From a self-regulated learning perspective, GenAI can assist planning, monitoring, and evaluation by helping students formulate questions, compare alternatives, request feedback, and identify gaps in understanding (Pintrich, 2004; Zimmerman, 2002). Used in this way, the tool functions as temporary cognitive scaffolding rather than a replacement for learning. Nevertheless, perceived academic achievement is not equivalent to verified performance. Students may perceive improvement because they complete assignments more rapidly or produce polished work, without necessarily retaining knowledge or demonstrating practical competence. Cotton et al. (2024), Perkins (2023), and Rudolph et al. (2023) cautioned that generated products may conceal limited understanding when central cognitive work is delegated to technology. The current result should therefore be interpreted as evidence of perceived progress, confidence, and efficiency, not objective proof of higher grades or improved practical performance.

5.4. Association between GenAI Use and the Educational Outcomes

The moderate positive relationship between GenAI use and the combined outcome supports the human-AI scaffolding perspective adopted in this study. GenAI can provide temporary support through explanations, examples, prompts, alternatives, feedback, and scenarios. Such support may help students generate ideas, explore multiple approaches, identify problems, organize academic work, and increase confidence. The finding is consistent with the educational opportunities described by Adiguzel et al. (2023), Kasneci et al. (2023), and Su and Yang (2023). The relationship with perceived academic achievement was slightly stronger than the relationship with overall creative thinking. Immediate benefits such as clarification, summarization, editing, organization, and feedback may be more visible to students than gradual changes in creative ability. Students can readily perceive that a task was completed more efficiently, whereas determining whether thinking has become more original or flexible is more difficult. The weaker relationship with originality reinforces the distinction between assistive productivity and independent creativity. GenAI can increase the amount and apparent quality of output without producing a corresponding increase in novelty. The correlational design also means that alternative explanations remain possible. Students with stronger digital literacy, motivation, self-regulation, or prior creative ability may use GenAI more strategically and critique its outputs more effectively. The relationship may therefore be reciprocal rather than unidirectional. Experimental and longitudinal studies are required to determine whether guided GenAI use produces sustained changes in creativity and achievement.

5.5. Gender Differences

No statistically significant gender differences were found in GenAI use, creative thinking, perceived academic achievement, or the combined outcome, and the effect sizes were very small. This result suggests that male and female students in the participating programs had broadly comparable opportunities, motivations, and capacities to use GenAI. Natural-language interfaces accessed through common computers and smartphones may present fewer technical barriers than earlier specialized technologies. The finding is consistent with Baer and Kaufman (2008), who concluded that gender differences in creativity are not universal and depend on domain, social expectations, opportunities, and measurement. In vocational education and public safety, perceived usefulness, digital literacy, prior experience, access, and instructional support may be more important than gender. However, the absence of mean differences does not necessarily imply identical patterns of use or identical concerns. Future research should examine whether gender interacts with specialization, academic level, prior digital experience, ethical awareness, or specific GenAI-use purposes.

5.6. Educational Implications

First, Jordanian universities should move beyond general encouragement or prohibition and embed explicit GenAI literacy within vocational education and public safety curricula. Students need practical guidance on prompt formulation, source verification, disclosure, privacy, bias, fabricated references, and the limitations of generated technical or safety advice. Second, instructors should design learning sequences in which GenAI extends rather than replaces thinking. Students can be required to define the problem independently, generate an initial solution, use GenAI to obtain alternatives, verify technical and academic claims, test feasibility, revise the response, and justify the final decision. Third, originality should be protected through authentic assessment. Tasks should address local workplace, school, safety, or community problems; require practical products or demonstrations; include drafts and documented revisions; and use oral defence or reflective explanation to make the student's reasoning visible. Fourth, GenAI should not replace workshops, field training, simulation, observation, or supervised performance. Vocational and public-safety competence depends on practical execution, risk awareness, professional judgment, communication, and adaptation to real conditions. Generated procedures must be checked against verified standards and regulations. Finally, faculty development is essential. Instructors need opportunities to experiment with GenAI, redesign assessments, establish clear disclosure expectations, evaluate process evidence, and distinguish acceptable assistance from inappropriate substitution.

6. Conclusion

This study examined the relationship between the use of generative artificial intelligence, creative thinking, and perceived academic achievement among vocational education and public safety students at five Jordanian universities. The results showed a high level of GenAI use, particularly for brainstorming and idea generation. Fluency, flexibility, problem sensitivity, and perceived academic achievement were high, whereas originality and overall creative thinking were medium. A statistically significant, moderate, and positive association was found between GenAI use and the combined outcome of creative thinking and perceived academic achievement. GenAI use was more strongly associated with perceived academic achievement, fluency, flexibility, and problem sensitivity than with originality. No statistically significant gender differences were identified, and the observed effect sizes were very small. The findings suggest that GenAI can serve as a valuable cognitive and academic support tool in applied university programs. It may help students generate alternatives, clarify concepts, plan lessons and activities, analyze occupational or safety scenarios, organize academic work, identify potential problems, and increase confidence. Nevertheless, high usage alone does not guarantee deep learning, practical competence, technical accuracy, safety judgment, or originality. The lower level of originality highlights the risk of reliance on common machine-generated patterns. GenAI should therefore be integrated through a human-centered approach in which students retain responsibility for defining problems, producing initial ideas, verifying information, testing feasibility and safety, revising outputs, and justifying final decisions. The educational value of the technology is greatest when it expands students' possibilities without replacing independent thought, applied practice, and professional responsibility.

6.1. Recommendations

1. Integrate responsible GenAI literacy into vocational education and public safety curricula at Jordanian universities.
2. Train students to verify academic, technical, occupational, and safety-related information generated by AI.
3. Require transparent disclosure of material GenAI use in assignments, projects, lesson plans, reports, and professional products.
4. Design authentic assessments that include drafts, practical demonstrations, simulations, reflective reports, and oral defences.
5. Require students to generate initial ideas independently before consulting GenAI.
6. Develop activities that require students to critique, compare, test, revise, and justify generated solutions.
7. Provide faculty development on ethical integration, prompt design, assessment redesign, and process-based evaluation.
8. Ensure that GenAI complements rather than replaces workshops, field training, practical experience, simulation, and professional supervision.
9. Develop institutional policies addressing privacy, intellectual ownership, fabricated references, bias, safety risks, and acceptable levels of assistance.
10. Provide equitable access to approved GenAI tools and digital-literacy support for all students.

6.2. Limitations

The findings should be interpreted in light of several limitations. The study used convenience sampling, which limits generalization to all vocational education and public safety students in Jordan. The cross-sectional design does not establish causal relationships. All variables were measured through self-report and may therefore be affected by social-desirability bias, inaccurate recall, or inflated perceptions of achievement. Academic achievement was perceived rather than measured through GPA, examinations, or externally evaluated performance. The study did not distinguish between specific GenAI tools, levels of prompting competence, types of assignments, or productive and substitutional forms of use. Self-reported creative thinking may not fully reflect performance on standardized divergent-thinking measures or authentic practical tasks. In addition, institution-specific participant frequencies were not available in the statistical summary used to prepare the manuscript, preventing analysis of university-level differences.

6.3. Suggestions for Future Research

Future research should use larger probability samples drawn from multiple Jordanian universities and a broader range of vocational education and public safety specializations. Longitudinal, experimental, and quasi-experimental designs are needed to determine whether structured GenAI use produces sustained changes in creative thinking, academic achievement, and practical performance.

- Compare perceived achievement with GPA, course grades, performance-based assessment, and delayed achievement tests.
- Use standardized divergent-thinking measures and authentic vocational or public-safety products.
- Examine the roles of digital literacy, AI literacy, self-regulation, motivation, critical thinking, and verification competence.
- Compare independent work, guided co-creative use, verification-based use, and unrestricted GenAI use.
- Investigate the quality, diversity, technical accuracy, and safety of products generated with and without GenAI support.
- Examine differences according to specialization, university, academic year, prior experience, and type of assignment.
- Explore instructors' perspectives on GenAI integration in vocational education and public safety programs.
- Evaluate whether process-based assessment protects originality, academic integrity, and professional competence.

GenAI should be understood as a potentially valuable partner in applied university learning rather than an autonomous producer of academic or professional work. Its value is greatest when it expands students' possibilities while preserving independent thought, practical engagement, source verification, reflective judgment, safety awareness, and responsibility for the final product.

Declarations

Ethics Approval and Consent to Participate

The study was conducted after obtaining the necessary institutional permissions. Participation was voluntary, informed consent was obtained, and no directly identifying information was collected. The authors should insert the formal ethics approval or exemption number if one was issued by the relevant institution.

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Conflict of Interest

The authors declare no conflict of interest.

Data Availability

An anonymized dataset and statistical output may be made available by the corresponding author upon reasonable request, subject to ethics approval and institutional data-protection requirements.

Artificial Intelligence Disclosure

Generative AI tools were used to support literature organization, language editing, and manuscript drafting. The human author is responsible for verifying every citation, factual statement, methodological detail, statistical result, interpretation, and final submission. No AI system is listed as an author.

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