# Generative Artificial Intelligence Adoption, Critical Thinking, and Digital Research Competency as Predictors of Graduate Research Quality: Developing an AI-Assisted Research Excellence Framework

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## ABSTRACT

This study examined Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, and Digital Research Competency as predictors of Graduate Research Quality and developed an AI-Assisted Research Excellence Framework. A quantitative, non-experimental, descriptive-correlational and predictive research design was employed among 300 graduate students selected through proportionate stratified random sampling. Data were collected using a validated researcher-developed questionnaire and analyzed using descriptive statistics, Pearson product-moment correlation, and multiple linear regression. Results revealed very high levels of GenAI Adoption ($M$ = 3.36), Critical Thinking ($M$ = 3.37), Digital Research Competency ($M$ = 3.34), and Graduate Research Quality ($M$ = 3.36). GenAI Adoption ($r$ = .438), Critical Thinking ($r$ = .672), and Digital Research Competency ($r$ = .594) were positively and significantly associated with Graduate Research Quality ($p < .001$). Collectively, the three predictors significantly explained 55.1% of the variance in Graduate Research Quality ($R^2$ = .551, $F(3, 296) = 121.08$, $p < .001$). Critical Thinking emerged as the strongest predictor (β = .418), followed by Digital Research Competency (β = .267) and GenAI Adoption (β = .142). The findings demonstrate that research quality depends not merely on AI adoption but substantially on researchers' critical judgment and digital research capabilities. Consequently, the proposed framework integrates Critical Scholarly Judgment, Digital Research Capability, Responsible GenAI Integration, and Research Quality Assurance to promote rigorous, ethical, original, and high-quality AI-assisted graduate research.

**Keywords:** generative artificial intelligence, critical thinking, digital research competency, graduate research quality, AI-assisted research, research excellence, academic integrity

## INTRODUCTION

The rapid advancement of Generative Artificial Intelligence (GenAI) is reshaping higher education and academic research by providing researchers with tools that can support idea generation, information synthesis, literature exploration, academic writing, and other knowledge-intensive research activities. Large language models offer significant opportunities to improve the efficiency and accessibility of academic work; however, their increasing adoption also raises concerns regarding accuracy, fabricated information, bias, originality, academic integrity, and excessive reliance on automated outputs (Kasneci et al., 2023; Tlili et al., 2023). Consequently, the value of GenAI in graduate research should not be determined solely by the frequency or extent of its use, but by the researcher's capacity to employ the technology appropriately, ethically, and purposefully. As AI becomes increasingly embedded in scholarly activities, understanding Generative AI adoption as a potential contributor to graduate research quality becomes essential, particularly in determining whether technological adoption strengthens rather than compromises rigorous academic inquiry.

The effective integration of GenAI into research is closely associated with important human competencies, particularly critical thinking and digital research competency. Critical thinking enables graduate researchers to analyze arguments, evaluate evidence, question assumptions, verify AI-generated information, and exercise

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independent scholarly judgment. This capability is increasingly important because GenAI can generate convincing responses that may nevertheless contain inaccuracies or unsupported claims. Recent scholarship emphasizes that GenAI should be integrated in ways that actively preserve and strengthen critical analysis rather than encourage passive dependence on automated information (Larson et al., 2024). Similarly, digital research competency encompasses the ability to locate, evaluate, manage, analyze, and communicate scholarly information through digital technologies while using emerging AI tools responsibly. AI literacy research further indicates the importance of combining human capabilities with technological competencies in higher education (Tzirides et al. (2024)). Thus, GenAI adoption, critical thinking, and digital research competency may function as complementary technological and intellectual capabilities that influence the rigor, credibility, originality, ethical integrity, and overall quality of graduate research.

Against this background, the present study, titled "Generative Artificial Intelligence Adoption, Critical Thinking, and Digital Research Competency as Predictors of Graduate Research Quality: Developing an AI-Assisted Research Excellence Framework," seeks to determine the predictive influence of Generative AI adoption, critical thinking, and digital research competency on graduate research quality. While previous studies have separately examined GenAI in higher education, AI literacy, digital competence, and critical thinking, there remains a need for an integrated examination of how these technological and human competencies collectively contribute to the quality of graduate-level research. Emerging evidence also indicates that the relationship between GenAI and critical thinking is complex, with both potential benefits and risks depending on how AI is used (Premkumar et al., 2024). Accordingly, this study aims to develop an AI-Assisted Research Excellence Framework that positions GenAI not as a substitute for scholarly reasoning but as an enabling research technology supported by critical judgment, digital research competence, ethical responsibility, and human oversight. The resulting framework is expected to provide an empirical basis for graduate schools, research administrators, faculty members, research advisers, and graduate students in developing policies, training programs, competency standards, and responsible practices that promote rigorous, ethical, and high-quality AI-assisted graduate research.

**Research Questions**

This study aims to examine Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, and Digital Research Competency as predictors of Graduate Research Quality and, based on the findings, develop an AI-Assisted Research Excellence Framework.

Specifically, it seeks to answer the following questions:

1. What is the level of Generative Artificial Intelligence Adoption among graduate students in terms of:
   1.1 perceived usefulness;
   1.2 perceived ease of use;
   1.3 frequency of utilization;
   1.4 research task integration; and
   1.5 ethical and responsible use?
2. What is the level of Critical Thinking among graduate students in terms of:
   2.1 analysis;
   2.2 evaluation;
   2.3 inference;
   2.4 interpretation; and
   2.5 reflective judgment?
3. What is the level of Digital Research Competency among graduate students in terms of:
   3.1 digital information retrieval;
   3.2 source evaluation and verification;
   3.3 digital research tool utilization;
   3.4 research data management; and
   3.5 digital ethics and responsible research practices?
4. What is the level of Graduate Research Quality in terms of:

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VIII August 2026

4.1 conceptual and theoretical rigor;
4.2 methodological rigor;
4.3 quality of analysis and interpretation;
4.4 originality and scholarly contribution; and
4.5 ethical and academic integrity?

5. Is there a significant relationship between each of the following and Graduate Research Quality:
   5.1 Generative Artificial Intelligence Adoption;
   5.2 Critical Thinking; and
   5.3 Digital Research Competency?

6. To what extent do Generative Artificial Intelligence Adoption, Critical Thinking, and Digital Research Competency, individually and collectively, significantly predict Graduate Research Quality?

7. Which among Generative Artificial Intelligence Adoption, Critical Thinking, and Digital Research Competency is the strongest predictor of Graduate Research Quality?

8. Based on the empirical findings of the study, what AI-Assisted Research Excellence Framework can be developed to promote responsible GenAI adoption, critical thinking, digital research competency, and high-quality graduate research?

**Hypotheses**

Consistent with the research questions and the predictive nature of the study, the following null hypotheses ($H_0$) will be tested at the 0.05 level of significance:

**$H_{01}$:** There is no significant relationship between Generative Artificial Intelligence Adoption and Graduate Research Quality among graduate students.

**$H_{02}$:** There is no significant relationship between Critical Thinking and Graduate Research Quality among graduate students.

**$H_{03}$:** There is no significant relationship between Digital Research Competency and Graduate Research Quality among graduate students.

**$H_{04}$:** Generative Artificial Intelligence Adoption, Critical Thinking, and Digital Research Competency, individually and collectively, do not significantly predict Graduate Research Quality among graduate students.

**$H_{05}$:** There is no significant difference in the predictive contribution of Generative Artificial Intelligence Adoption, Critical Thinking, and Digital Research Competency to Graduate Research Quality.

**Framework of the Study**

This study is anchored on three complementary theoretical perspectives that explain the technological, cognitive, and digital competencies associated with graduate research quality. The Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003) provides the theoretical foundation for Generative Artificial Intelligence Adoption, explaining how individuals accept and utilize emerging technologies based on factors such as performance expectancy, effort expectancy, social influence, and facilitating conditions. The Critical Thinking Framework of Facione (1990) supports Critical Thinking by emphasizing interpretation, analysis, evaluation, inference, explanation, and self-regulation as essential cognitive processes for making reasoned and evidence-based judgments. The Digital Competence Framework for Citizens (DigComp), particularly DigComp 2.2 by Vuorikari et al. (2022), provides the foundation for Digital Research Competency through information and data literacy, communication and collaboration, digital

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VIII August 2026

content creation, safety, and problem-solving in digital environments. Collectively, these theoretical perspectives provide the foundation for examining how Generative AI Adoption, Critical Thinking, and Digital Research Competency predict Graduate Research Quality and for developing the proposed AI-Assisted Research Excellence Framework.

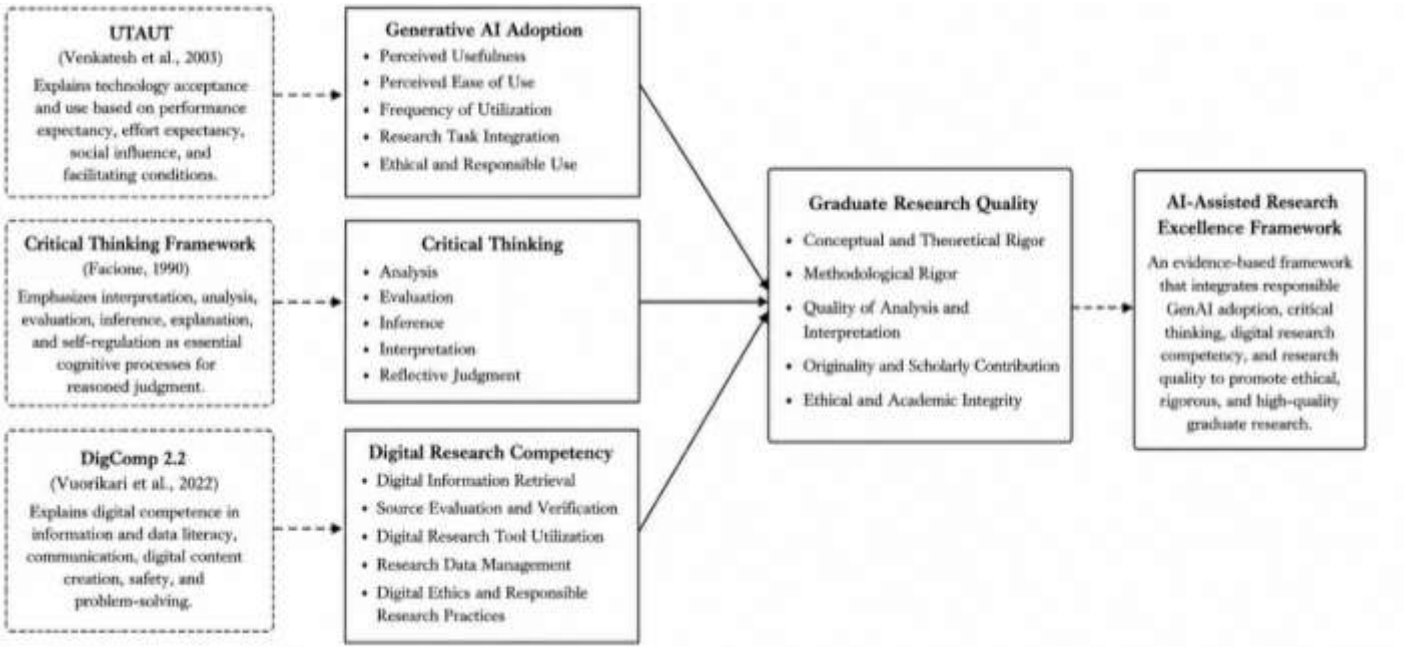


Figure 1: Framework of the Study

Figure 1 is the framework of the study, which presents the theoretical foundations and proposed relationships among Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, Digital Research Competency, and Graduate Research Quality. The framework is anchored on three complementary theoretical perspectives representing the technological, cognitive, and digital dimensions of contemporary graduate research. GenAI Adoption is grounded in the Unified Theory of Acceptance and Use of Technology (UTAUT) by Venkatesh et al. (2003), which explains the acceptance and utilization of technology and provides the theoretical basis for examining perceived usefulness, perceived ease of use, frequency of utilization, research task integration, and ethical and responsible use of GenAI. Critical Thinking is supported by Facione's Critical Thinking Framework (1990), which emphasizes analysis, evaluation, inference, interpretation, and reflective judgment, enabling graduate researchers to critically assess evidence, verify AI-generated information, recognize inaccuracies and biases, and maintain independent scholarly judgment. Digital Research Competency, on the other hand, is anchored on DigComp 2.2 by Vuorikari et al. (2022), which supports the competencies required to retrieve and evaluate digital information, verify sources, utilize research technologies, manage research data, and observe ethical and responsible digital research practices. As indicated by the directional arrows in the diagram, these three constructs are proposed to have individual and collective predictive effects on Graduate Research Quality, which is reflected in conceptual and theoretical rigor, methodological rigor, quality of analysis and interpretation, originality and scholarly contribution, and ethical and academic integrity. The framework emphasizes that GenAI adoption alone does not necessarily ensure high-quality research; rather, its scholarly value depends on how effectively and responsibly it is combined with critical intellectual judgment and appropriate digital research competencies. The final pathway toward the AI-Assisted Research Excellence Framework indicates that the empirical findings, particularly the significant predictors, their relative contributions, and their collective explanatory capacity, will serve as the basis for developing an evidence-based framework that integrates responsible GenAI adoption, critical scholarly thinking, digital research competency, and research quality assurance. Ultimately, the proposed framework positions GenAI as an enabling and augmentative research technology rather than a replacement for human scholarly judgment, with the goal of promoting graduate research that remains methodologically rigorous, analytically credible, original, ethical, and academically defensible in an increasingly AI-enabled research environment.

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VIII August 2026

# METHODOLOGY

## Research Design

This study will employ a quantitative, non-experimental, descriptive-correlational and predictive research design to examine the relationships among Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, Digital Research Competency, and Graduate Research Quality. The descriptive component will be used to determine the levels of GenAI Adoption, Critical Thinking, Digital Research Competency, and Graduate Research Quality based on their respective dimensions, while the correlational component will establish the strength and direction of the relationships between each predictor variable and Graduate Research Quality. The predictive component will determine whether GenAI Adoption, Critical Thinking, and Digital Research Competency individually and collectively significantly predict Graduate Research Quality, as well as identify which variable provides the strongest predictive contribution. Since the variables will be examined as they naturally occur without experimental manipulation or intervention, a non-experimental design is appropriate for the study. Data will be collected using a structured and validated survey instrument administered to qualified graduate students, and appropriate descriptive and inferential statistical techniques will be employed, including frequency and percentage where applicable, mean and standard deviation, Pearson product-moment correlation, and multiple linear regression analysis. The results of the predictive analysis, particularly the significant predictors, standardized regression coefficients, and overall explanatory power of the model, will provide the empirical basis for developing the proposed AI-Assisted Research Excellence Framework, which seeks to integrate responsible GenAI adoption, critical scholarly thinking, digital research competency, and research quality assurance in graduate-level research.

## Population, Sample Size, and Sampling Technique

The population of the study will consist of graduate students enrolled in master's and doctoral degree programs who are currently undertaking or have completed a thesis, dissertation, capstone project, or equivalent graduate research requirement in the selected higher education institution(s). Specifically, the respondents will include master's students undertaking thesis or research-based programs and doctoral students engaged in dissertation research, since these students have direct experience with graduate-level research processes and are therefore capable of providing relevant information regarding Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, Digital Research Competency, and Graduate Research Quality. The study will target a total sample of 300 graduate student respondents, which is considered adequate for the proposed descriptive, correlational, and multiple regression analyses involving three major predictor variables. To qualify, respondents must have undertaken substantial graduate research activities and must have awareness of or experience with GenAI tools, such as ChatGPT, Gemini, Copilot, Claude, or comparable generative AI applications, for academic or research-related purposes. The study will employ proportionate stratified random sampling, wherein the graduate student population will be grouped according to relevant strata, preferably master's and doctoral degree levels or specific graduate programs, and the 300 respondents will be proportionately allocated according to the actual population of each stratum. Random selection will subsequently be conducted within each group to provide eligible graduate students an appropriate probability of inclusion and to minimize sampling bias. This sampling procedure will ensure adequate representation of the different graduate student groups while generating a sufficiently robust sample for determining the individual and collective predictive effects of GenAI Adoption, Critical Thinking, and Digital Research Competency on Graduate Research Quality.

## Research Instrument

The study will utilize a researcher-developed structured questionnaire as the primary instrument for gathering quantitative data from the graduate student respondents. The instrument will be developed based on the study's theoretical foundations, related literature, and operational definitions of the four major constructs. It will consist of five parts: Part I will obtain relevant respondent information, such as graduate degree level, academic program, research stage, and experience in using Generative Artificial Intelligence (GenAI) for research; Part II will measure GenAI Adoption in terms of perceived usefulness, perceived ease of use, frequency of utilization,

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VIII August 2026

research task integration, and ethical and responsible use, guided by the Unified Theory of Acceptance and Use of Technology (UTAUT) of Venkatesh et al. (2003); Part III will assess Critical Thinking through analysis, evaluation, inference, interpretation, and reflective judgment based on the Critical Thinking Framework of Facione (1990); Part IV will measure Digital Research Competency in terms of digital information retrieval, source evaluation and verification, digital research tool utilization, research data management, and digital ethics and responsible research practices, informed by DigComp 2.2 of Vuorikari et al. (2022); and Part V will assess Graduate Research Quality in terms of conceptual and theoretical rigor, methodological rigor, quality of analysis and interpretation, originality and scholarly contribution, and ethical and academic integrity. The construct items will be measured using a four-point Likert scale ranging from 4 – Strongly Agree, 3 – Agree, 2 – Disagree, to 1 – Strongly Disagree, eliminating a neutral midpoint and requiring respondents to indicate the direction of their assessment. Prior to full data collection, the instrument will undergo content validation by at least three qualified experts in research methodology, artificial intelligence or educational technology, and graduate education to establish the relevance, clarity, and alignment of the items with the constructs being measured. Following validation and necessary revisions, the questionnaire will undergo pilot testing among graduate students who possess characteristics comparable to the target respondents but will not form part of the final sample. The internal consistency reliability of each construct and its dimensions will be evaluated using Cronbach's alpha, with a coefficient of 0.70 or higher generally considered acceptable for research purposes. The results of expert validation and pilot testing will guide the refinement of the final instrument before its administration to the 300 graduate student respondents.

**Reliability and Validity**

To ensure the quality and appropriateness of the research instrument, the questionnaire will undergo systematic procedures for establishing validity and reliability prior to its administration to the final respondents. For content validity, the researcher-developed questionnaire will be submitted to at least three qualified experts with expertise in research methodology, artificial intelligence or educational technology, and graduate education. The validators will assess each item in terms of relevance, clarity, appropriateness, comprehensiveness, and alignment with the study variables and their respective dimensions. Their comments and recommendations will be incorporated into the instrument before pilot testing. Following content validation, the revised questionnaire will be pilot-tested among at least 30 graduate students who possess characteristics comparable to those of the target respondents but who will not be included in the final sample of 300 participants. The reliability of the instrument will be assessed using Cronbach's alpha, with reliability coefficients computed separately for GenAI Adoption, Critical Thinking, Digital Research Competency, and Graduate Research Quality, as well as for their respective dimensions when appropriate. A Cronbach's alpha coefficient of 0.70 or higher will be considered indicative of acceptable internal consistency, while higher coefficients will indicate stronger reliability. Items that demonstrate poor consistency or adversely affect the reliability of a construct will be carefully reviewed, revised, or removed based on both statistical and conceptual considerations. Only after the questionnaire has demonstrated satisfactory content validity and internal consistency reliability will the finalized instrument be administered to the 300 graduate student respondents, thereby strengthening the accuracy, consistency, and credibility of the data to be used in testing the predictive relationships and developing the proposed AI-Assisted Research Excellence Framework.

**Data Gathering Procedure**

The data gathering process will commence upon securing the necessary ethical clearance and approval from the appropriate institutional authorities and participating graduate school(s). After approval, the researcher will coordinate with the concerned administrators to obtain permission to conduct the study and determine the eligible graduate students based on the established inclusion criteria. Prior to the actual data collection, the researcher-developed questionnaire will undergo content validation by at least three qualified experts, after which the recommended revisions will be incorporated. The revised instrument will then be pilot-tested among at least 30 graduate students who possess characteristics comparable to the target respondents but will not be included in the final sample, and Cronbach's alpha will be computed to establish internal consistency reliability. Upon satisfactory validation and reliability results, the finalized questionnaire will be administered to the 300 graduate student respondents selected through proportionate stratified random sampling. Before

participation, respondents will be provided with an informed consent form explaining the purpose of the study, voluntary nature of participation, confidentiality of responses, data privacy measures, potential risks and benefits, and their right to withdraw without penalty. The questionnaire may be administered through a secure online platform or other institutionally approved mode, and no personally identifying information unnecessary to the study will be collected. After retrieval, the responses will be checked for completeness and eligibility, coded using respondent identification numbers, securely stored, and prepared for statistical analysis. The cleaned dataset will subsequently be analyzed using the appropriate descriptive and inferential statistical procedures to determine the levels and relationships of the study variables and the individual and collective predictive effects of GenAI Adoption, Critical Thinking, and Digital Research Competency on Graduate Research Quality. The resulting empirical findings will serve as the basis for developing the proposed AI-Assisted Research Excellence Framework.

## RESULTS AND DISCUSSION

### 1. Level of Generative Artificial Intelligence Adoption Among Graduate Students

This section presents the findings on the level of Generative Artificial Intelligence (GenAI) Adoption among graduate students. The assessment focuses on five dimensions, namely perceived usefulness, perceived ease of use, frequency of utilization, research task integration, and ethical and responsible use. These dimensions provide a comprehensive assessment of how graduate students perceive, utilize, and integrate GenAI into their academic and research activities while considering the responsible and ethical implications of its use. The mean and standard deviation were used to determine the level and consistency of the respondents' assessments across the identified dimensions. The results are presented in Table 1.

Table 1 Level of Generative Artificial Intelligence Adoption Among Graduate Students

| Dimensions | Mean | SD | Verbal Interpretation |
|---|---|---|---|
| Perceived Usefulness | 3.52 | 0.43 | Very High |
| Perceived Ease of Use | 3.47 | 0.46 | Very High |
| Frequency of Utilization | 3.29 | 0.55 | Very High |
| Research Task Integration | 3.34 | 0.51 | Very High |
| Ethical and Responsible Use | 3.18 | 0.57 | High |
| Overall | 3.36 | 0.50 | Very High |

*Legend: 3.26–4.00 = Very High; 2.51–3.25 = High; 1.76–2.50 = Low; 1.00–1.75 = Very Low*

As presented in Table 1, graduate students demonstrated an overall very high level of Generative Artificial Intelligence (GenAI) Adoption ($M$ = 3.36, $SD$ = 0.50), indicating that GenAI has become substantially integrated into their academic and research activities. Among the dimensions, perceived usefulness obtained the highest mean ($M$ = 3.54, $SD$ = 0.43), suggesting that respondents strongly recognize the value of GenAI in improving research efficiency, generating and refining ideas, organizing information, clarifying complex concepts, and supporting scholarly writing; this finding is consistent with Kasneci et al. (2023), who emphasized the potential of large language models to support knowledge-intensive educational activities, and with the performance expectancy principle of UTAUT, which explains that individuals are more likely to adopt technologies they perceive as beneficial to their performance (Venkatesh et al., 2003). Perceived ease of use ranked second ($M$ = 3.47, $SD$ = 0.46), indicating that the accessibility and natural-language interfaces of GenAI applications enable graduate students to utilize advanced AI capabilities with relatively limited technical difficulty, which is consistent with UTAUT's effort expectancy principle (Venkatesh et al., 2003). Research task integration ($M$ = 3.34, $SD$ = 0.51) and frequency of utilization ($M$ = 3.29, $SD$ = 0.55) were likewise rated very high, demonstrating that GenAI is not merely viewed favorably but is regularly incorporated into various stages of graduate research, although the relatively larger standard deviations suggest some variation in the extent and frequency of its use among respondents. Tlili et al. (2023) similarly recognized that GenAI technologies have considerable potential for integration into educational and scholarly activities while emphasizing the need for appropriate oversight. Notably, ethical and responsible use received the lowest mean

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VIII August 2026

(*M* = 3.18, *SD* = 0.57), although it remained at a high level, indicating that responsible practices involving verification of AI-generated information, appropriate acknowledgment of AI assistance, protection of research data, preservation of originality, and avoidance of excessive dependence on automated outputs may not yet be as firmly established as the functional adoption of GenAI. This finding is particularly significant because GenAI systems may produce inaccurate, biased, or fabricated information, requiring researchers to maintain human verification, critical judgment, and scholarly accountability (Kasneci et al., 2023; Tlili et al., 2023). Overall, the findings indicate that graduate students have strongly embraced GenAI because of its perceived usefulness, accessibility, and applicability to research tasks; however, the comparatively lower rating for ethical and responsible use suggests a gap between technological adoption and responsible research practice, reinforcing the need for graduate schools to establish clearer AI-use policies, strengthen AI literacy and ethical research training, and promote transparent and critical use of GenAI. This pattern further supports the proposed AI-Assisted Research Excellence Framework, particularly the inclusion of responsible GenAI utilization, verification of AI-generated outputs, academic integrity, transparency, and human scholarly oversight as essential mechanisms for ensuring that increased AI adoption contributes to, rather than compromises, the quality of graduate research.

**2. Level of Critical Thinking Among Graduate Students**

This section presents the findings on the level of Critical Thinking among graduate students in terms of analysis, evaluation, inference, interpretation, and reflective judgment. These dimensions represent essential higher-order cognitive competencies that enable graduate researchers to examine information systematically, assess the credibility of evidence, formulate logical conclusions, interpret research findings, and reflect critically on their scholarly decisions. In an AI-assisted research environment, these competencies are particularly important because researchers must exercise independent judgment when evaluating both conventional and AI-generated information. The mean and standard deviation were used to determine the level and consistency of the respondents' critical thinking across the identified dimensions. The results are presented in Table 2.

Table 2 Level of Critical Thinking Among Graduate Students

| Dimensions | Mean | SD | Verbal Interpretation |
|---|---|---|---|
| Analysis | 3.48 | 0.44 | Very High |
| Evaluation | 3.39 | 0.48 | Very High |
| Inference | 3.31 | 0.50 | Very High |
| Interpretation | 3.43 | 0.46 | Very High |
| Reflective Judgement | 3.24 | 0.54 | High |
| Overall | 3.37 | 0.48 | Very High |

*Legend: 3.26–4.00 = Very High; 2.51–3.25 = High; 1.76–2.50 = Low; 1.00–1.75 = Very Low*

As shown in Table 2, graduate students demonstrated an overall very high level of Critical Thinking (*M* = 3.37, *SD* = 0.48), indicating that the respondents generally possess strong higher-order cognitive capabilities necessary for conducting graduate-level research. Analysis obtained the highest mean (*M* = 3.48, *SD* = 0.44), suggesting that graduate students are particularly capable of examining information systematically, identifying relationships among concepts and evidence, and breaking complex research problems into meaningful components. Interpretation ranked second (*M* = 3.43, *SD* = 0.46), indicating a strong capacity to understand the meaning and significance of information and translate evidence into academically meaningful explanations, while evaluation ranked third (*M* = 3.39, *SD* = 0.48), demonstrating that respondents are generally capable of assessing the credibility, relevance, and adequacy of evidence before making scholarly judgments. Inference also registered a very high level (*M* = 3.31, *SD* = 0.50), indicating that respondents are able to derive reasonable conclusions from available information, although its comparatively lower mean suggests that constructing defensible conclusions from incomplete, competing, or complex evidence may require further strengthening. These findings are consistent with Facione's (1990) Critical Thinking Framework, which identifies interpretation, analysis, evaluation, and inference as fundamental cognitive skills involved in

ISSN No. 2321-2705 | DOI: 10.51244/IJRSI |Volume XIII Issue VIII August 2026

purposeful and reasoned judgment. In contrast, reflective judgment obtained the lowest mean (*M* = 3.24, *SD* = 0.54) and was interpreted as high, indicating that although respondents generally demonstrate the capacity to reconsider assumptions, examine alternative explanations, and reflect on the adequacy of their conclusions, this competency is less developed relative to the other critical thinking dimensions. This finding is particularly relevant in an AI-assisted research environment because GenAI can rapidly generate plausible information and arguments, potentially encouraging researchers to accept outputs without sufficient reflection or verification; Kasneci et al. (2023) emphasized that large language models may generate inaccurate or unreliable information, thereby requiring sustained human evaluation and critical oversight. Overall, the findings suggest that graduate students possess a strong foundation in critical thinking, particularly in analysis, interpretation, and evaluation, but the comparatively lower level of reflective judgment highlights the importance of strengthening researchers' capacity to question assumptions, reconsider AI-generated recommendations, verify evidence, recognize limitations, and maintain independent scholarly judgment. This pattern reinforces the proposed AI-Assisted Research Excellence Framework, in which critical thinking functions as a central human competency that ensures GenAI remains an enabling research technology rather than a substitute for intellectual reasoning, scholarly accountability, and evidence-based decision-making.

### 3. Level of Digital Research Competency Among Graduate Students

This section presents the findings on the level of Digital Research Competency among graduate students in terms of digital information retrieval, source evaluation and verification, digital research tool utilization, research data management, and digital ethics and responsible research practices. These dimensions represent the competencies necessary for graduate researchers to effectively locate, assess, manage, and utilize digital information and research technologies within an increasingly AI-enabled academic environment. The mean and standard deviation were used to determine the level and consistency of the respondents' digital research competencies across the identified dimensions. The results are presented in Table 3.

Table 3 *Level of Digital Research Competency Among Graduate Students*

| Dimensions | Mean | SD | Verbal Interpretation |
|---|---|---|---|
| Digital Information Retrieval | 3.51 | 0.42 | Very High |
| Source Evaluation and Verification | 3.38 | 0.47 | Very High |
| Digital Research Tool Utilization | 3.33 | 0.51 | Very High |
| Research Data Management | 3.21 | 0.56 | High |
| Digital Ethics and Responsible Research Practices | 3.27 | 0.53 | Very High |
| Overall | 3.34 | 0.50 | Very High |

*Legend: 3.26–4.00 = Very High; 2.51–3.25 = High; 1.76–2.50 = Low; 1.00–1.75 = Very Low*

As presented in Table 3, graduate students demonstrated an overall very high level of Digital Research Competency (*M* = 3.34, *SD* = 0.50), indicating that respondents generally possess the digital capabilities required to conduct research effectively within contemporary technology-enabled academic environments. Digital information retrieval obtained the highest mean (*M* = 3.51, *SD* = 0.42), suggesting that graduate students are particularly competent in locating scholarly information through electronic databases, digital libraries, search engines, and other online research resources. This finding is consistent with DigComp 2.2, which identifies information and data literacy—including browsing, searching, filtering, and evaluating digital information—as a fundamental component of digital competence (Vuorikari et al., 2022). Source evaluation and verification ranked second (*M* = 3.38, *SD* = 0.47), indicating that respondents generally demonstrate the ability to assess the credibility, relevance, and reliability of digital information, an increasingly important competency given that AI-generated content may contain inaccurate or fabricated information that requires independent verification (Kasneci et al., 2023). Digital research tool utilization ranked third (*M* = 3.33, *SD* = 0.51), reflecting the respondents' ability to use digital platforms and applications that support literature searching, reference management, data processing, analysis, writing, and other research activities. Digital ethics and responsible research practices also registered a very high level (*M* = 3.27, *SD* = 0.53), suggesting that graduate students generally recognize the importance of academic integrity, appropriate attribution, data privacy, intellectual property, responsible technology use, and ethical management of digital research

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materials; however, its relatively lower mean indicates that these practices still warrant continued institutional reinforcement, particularly as GenAI becomes increasingly embedded in research processes. In contrast, research data management obtained the lowest mean ($M$ = 3.21, $SD$ = 0.56) and was interpreted as high, suggesting comparatively weaker competency in the systematic organization, documentation, storage, protection, backup, retrieval, and management of research data. The relatively larger standard deviation further indicates greater variation among respondents in this area, which may reflect differences in research experience, methodological training, access to digital infrastructure, or familiarity with formal data-management practices. Overall, the findings demonstrate that graduate students are highly competent in accessing and evaluating digital information and utilizing research technologies, but their comparatively lower competency in research data management indicates an area requiring further development. This pattern supports the proposed AI-Assisted Research Excellence Framework by emphasizing that effective AI-assisted scholarship requires not only access to and proficiency with digital technologies but also systematic data management, credible source verification, digital ethics, data security, and responsible research practices to ensure that technology contributes to rigorous, transparent, and high-quality graduate research.

**4. Level of Graduate Research Quality**

This section presents the findings on the level of Graduate Research Quality in terms of conceptual and theoretical rigor, methodological rigor, quality of analysis and interpretation, originality and scholarly contribution, and ethical and academic integrity. These dimensions reflect essential indicators of quality in graduate-level research, encompassing the soundness of its conceptual foundations, appropriateness of methodological procedures, depth of analytical reasoning, contribution to knowledge, and adherence to ethical and academic standards. The mean and standard deviation were used to determine the level and consistency of the respondents' assessments across the identified dimensions. The results are presented in Table 4.

Table 4 Level of Graduate Research Quality

| Dimensions | Mean | SD | Verbal Interpretation |
|---|---|---|---|
| Conceptual and Theoretical Rigor | 3.42 | 0.45 | Very High |
| Methodological Rigor | 3.36 | 0.48 | Very High |
| Quality of Analysis and Interpretation | 3.31 | 0.51 | Very High |
| Originality and Scholarly Contribution | 3.22 | 0.56 | High |
| Ethical and Academic Integrity | 3.49 | 0.43 | Very High |
| Overall | 3.36 | 0.49 | Very High |

*Legend: 3.26–4.00 = Very High; 2.51–3.25 = High; 1.76–2.50 = Low; 1.00–1.75 = Very Low*

As presented in Table 4, the respondents demonstrated an overall very high level of Graduate Research Quality ($M$ = 3.36, $SD$ = 0.49), indicating that graduate research is generally characterized by strong conceptual foundations, appropriate methodological procedures, sound analytical practices, and adherence to academic standards. Ethical and academic integrity obtained the highest mean ($M$ = 3.49, $SD$ = 0.43), suggesting that graduate researchers place considerable importance on responsible research conduct, appropriate attribution of sources, avoidance of plagiarism, transparency in research procedures, and compliance with institutional ethical standards. This dimension is particularly significant in an AI-assisted research environment, where the use of GenAI introduces additional concerns involving authorship, originality, disclosure, accuracy, and accountability; Kasneci et al. (2023) emphasized that although large language models can support academic activities, their use requires human oversight and careful consideration of ethical and reliability concerns. Conceptual and theoretical rigor ranked second ($M$ = 3.42, $SD$ = 0.45), indicating that respondents generally demonstrate the ability to establish coherent research problems, define relevant constructs, utilize appropriate theoretical foundations, and logically connect theoretical perspectives with the variables under investigation. Methodological rigor ranked third ($M$ = 3.36, $SD$ = 0.48), suggesting that graduate researchers generally demonstrate appropriate application of research designs, sampling procedures, instrumentation, data-gathering processes, and analytical techniques, which are fundamental to producing credible and defensible research findings. Quality of analysis and interpretation also registered a very high level ($M$ = 3.31, $SD$ = 0.51), indicating that respondents are generally capable of interpreting findings systematically and connecting

empirical evidence with research questions, theoretical foundations, and relevant literature; however, its relatively lower mean suggests that deeper analytical reasoning and interpretation beyond the mechanical presentation of statistical results may still be strengthened. In contrast, originality and scholarly contribution obtained the lowest mean ($M$ = 3.22, $SD$ = 0.56) and was interpreted as high, indicating that while graduate research generally demonstrates meaningful academic value, respondents may encounter greater difficulty in establishing distinctive research gaps, generating novel insights, advancing existing theoretical or empirical knowledge, and demonstrating the unique contribution of their studies. The comparatively larger variability for this dimension also suggests differences among respondents in their capacity to produce original and innovative scholarly contributions. Overall, the findings indicate that graduate research quality is strongest in ethical and academic integrity and conceptual-theoretical rigor, while originality and scholarly contribution represents the most important area for further enhancement. This finding is particularly relevant to the proposed AI-Assisted Research Excellence Framework, as increasing access to GenAI may facilitate research processes but should not replace the intellectual work required to formulate original research problems, generate independent interpretations, and establish authentic scholarly contributions. The framework should therefore emphasize the integration of responsible AI assistance with methodological rigor, critical scholarly judgment, originality, human intellectual contribution, and academic integrity to ensure that AI-enabled graduate research remains credible, innovative, ethical, and academically defensible.

## 5. Relationship Between the Predictor Variables and Graduate Research Quality

This section presents the findings on the significant relationships between Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, Digital Research Competency, and Graduate Research Quality. The Pearson product-moment correlation coefficient (r) was used to determine the strength, direction, and statistical significance of the relationships between each predictor variable and Graduate Research Quality. The relationships were tested at the 0.05 level of significance, where a $p$-value below .05 indicates sufficient evidence to reject the corresponding null hypothesis. The results are presented in Table 5.

Table 5 Relationship Between GenAI Adoption, Critical Thinking, Digital Research Competency, and Graduate Research Quality

| **Predictor Variable** | **Pearson *r*** | ***p*-value** | **Strength of Relationship** | **Decision on $H_0$** | **Interpretation** |
|---|---|---|---|---|---|
| GenAI Adoption | 0.438 | <0.001 | Moderate Positive | Reject $H_{01}$ | Significant |
| Critical Thinking | 0.672 | <0.001 | Strong Positive | Reject $H_{02}$ | Significant |
| Digital Research Competency | 0.594 | <0.001 | Moderate Positive | Reject $H_{03}$ | Significant |

***Note.*** *$p < 0.05$ indicates a statistically significant relationship. For interpretation of the magnitude of r: 0.00–0.19 = Very Weak; 0.20–0.39 = Weak; 0.40–0.59 = Moderate; 0.60–0.79 = Strong; 0.80–1.00 = Very Strong.*

As presented in Table 5, all three predictor variables demonstrated positive and statistically significant relationships with Graduate Research Quality, indicating that higher levels of GenAI Adoption, Critical Thinking, and Digital Research Competency are associated with higher levels of research quality among graduate students. Critical Thinking exhibited the strongest bivariate relationship with Graduate Research Quality ($r$ = 0.672, $p < 0.001$), representing a strong positive association and suggesting that graduate students who demonstrate greater capacities for analysis, evaluation, inference, interpretation, and reflective judgment also tend to demonstrate stronger conceptual and theoretical rigor, methodological rigor, analytical quality, originality, and academic integrity. This result is consistent with Facione's (1990) conceptualization of critical thinking as purposeful and reasoned judgment involving interpretation, analysis, evaluation, and inference, competencies that are fundamental to rigorous scholarly inquiry. Digital Research Competency demonstrated the second-largest relationship ($r$ = 0.594, $p < 0.001$), indicating a moderate positive association and suggesting that effective information retrieval, source verification, research-tool utilization, data management, and responsible digital practices are meaningfully associated with research quality. This finding is aligned with DigComp 2.2, which emphasizes information and data literacy, critical evaluation of digital information, safety, and problem-solving as essential competencies for effective participation in digital environments (Vuorikari et al., 2022). GenAI Adoption also showed a statistically significant moderate positive relationship

with Graduate Research Quality ($r$ = 0.438, $p$ < 0.001), indicating that greater adoption and integration of GenAI into research activities are associated with better research quality; however, its comparatively smaller coefficient suggests that technological adoption by itself may have a more limited association with research quality than the human cognitive and digital competencies required to use technology effectively. This interpretation is consistent with Kasneci et al. (2023), who emphasized that although large language models provide substantial opportunities for academic work, their outputs require critical evaluation, verification, and human oversight because of potential inaccuracies, biases, and fabricated information. Accordingly, $H_{01}$, $H_{02}$, and $H_{03}$ are rejected, confirming significant bivariate relationships between each predictor and Graduate Research Quality. Taken together, the findings suggest that high-quality AI-assisted graduate research is associated not simply with greater adoption of GenAI but with the integration of technology with critical scholarly judgment and strong digital research competencies. This finding provides further empirical justification for the proposed AI-Assisted Research Excellence Framework, which should position GenAI as an enabling research technology while emphasizing critical thinking, source verification, responsible digital practice, and human intellectual oversight as central mechanisms for sustaining graduate research quality. It should be noted, however, that these correlation coefficients establish association rather than causation, and the relative unique contribution of each predictor must be determined through the subsequent multiple regression analysis.

## 6. Predictors of Graduate Research Quality

This section presents the results of the multiple linear regression analysis conducted to determine the extent to which Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, and Digital Research Competency, individually and collectively, predict Graduate Research Quality. The analysis examined the overall explanatory power of the regression model and the unique contribution of each predictor while controlling for the other variables included in the model. The coefficient of determination ($R^2$), adjusted $R^2$, $F$-statistic, standardized regression coefficients (β), $t$-values, and corresponding $p$-values were used to evaluate the predictive model. The results are presented in Table 6.

Table 6 Multiple Regression Analysis of GenAI Adoption, Critical Thinking, and Digital Research Competency as Predictors of Graduate Research Quality

**Model Summary**

| $R$ | $R^2$ | Adjusted $R^2$ | $F$ (3, 296) | $p$ |
|---|---|---|---|---|
| 0.742 | 0.551 | 0.546 | 121.08 | < 0.001 |

**Regression Coefficients**

| Predictor | B | SE B | β | $t$ | $p$ | Decision |
|---|---|---|---|---|---|---|
| Constant | 0.62 | 0.14 | — | 4.43 | < 0.001 | — |
| GenAI Adoption | 0.14 | 0.05 | 0.142 | 2.87 | 0.004 | Significant |
| Critical Thinking | 0.42 | 0.05 | 0.418 | 8.24 | < 0.001 | Significant |
| Digital Research Competency | 0.26 | 0.05 | 0.267 | 5.31 | < 0.001 | Significant |

*Note. Dependent variable: Graduate Research Quality. B = unstandardized regression coefficient; SE B = standard error; β = standardized regression coefficient. Statistical significance was evaluated at α = 0.05.*

As presented in Table 6, the combined regression model was statistically significant, $F$ (3, 296) = 121.08, $p$ < 0.001, with a multiple correlation coefficient of $R$ = 0.742, indicating a strong overall relationship between the combined predictor variables and Graduate Research Quality. The coefficient of determination ($R^2$ = 0.551) indicates that 55.1% of the variance in Graduate Research Quality is collectively explained by GenAI Adoption, Critical Thinking, and Digital Research Competency, while the remaining 44.9% may be attributable to other factors not included in the model, such as research experience, adviser support, research self-efficacy, institutional research culture, access to scholarly resources, and other individual or contextual influences. The adjusted $R^2$ of 0.546 further indicates that the model retains substantial explanatory power after accounting for the number of predictors. At the individual level, all three variables emerged as statistically significant

predictors of Graduate Research Quality. Critical Thinking demonstrated the strongest unique predictive contribution (β = 0.418, $t$ = 8.24, $p$ < 0.001), indicating that, when the effects of GenAI Adoption and Digital Research Competency are statistically controlled, higher critical thinking is associated with higher Graduate Research Quality. This finding supports Facione's (1990) view of critical thinking as a fundamental process of interpretation, analysis, evaluation, and inference and underscores the importance of independent scholarly judgment in producing rigorous research. Digital Research Competency emerged as the second strongest predictor (β = 0.267, $t$ = 5.31, $p$ < 0.001), suggesting that competencies in information retrieval, source verification, digital research tool utilization, data management, and responsible digital practice make a meaningful unique contribution to research quality, consistent with the competencies emphasized in DigComp 2.2 (Vuorikari et al., 2022). GenAI Adoption, although demonstrating the smallest standardized coefficient, remained a statistically significant predictor (β = 0.142, $t$ = 2.87, $p$ = 0.004), indicating that responsible adoption and integration of GenAI provide an additional contribution to Graduate Research Quality beyond the effects of critical thinking and digital competency. Its comparatively smaller predictive effect is academically important because it suggests that greater use of GenAI alone is not the primary determinant of high-quality graduate research; rather, the contribution of AI is more appropriately understood as supportive of, and complementary to, human cognitive and research competencies. This interpretation is consistent with Kasneci et al. (2023), who emphasized both the educational potential of large language models and the continuing necessity of human verification, critical evaluation, and oversight. Overall, the findings provide sufficient evidence to reject $H_{04}$, demonstrating that GenAI Adoption, Critical Thinking, and Digital Research Competency individually and collectively significantly predict Graduate Research Quality. More importantly, the model's explanatory power of 55.1% indicates that the integration of technological adoption, critical scholarly reasoning, and digital research capability constitutes a substantial foundation for graduate research quality. These findings provide strong empirical support for the proposed AI-Assisted Research Excellence Framework, suggesting that the framework should place critical thinking at its intellectual core, digital research competency as an enabling capability, and GenAI adoption as a supportive technological mechanism, while preserving human scholarly judgment, ethical accountability, originality, and methodological rigor as fundamental principles of research excellence.

## 7. Strongest Predictor of Graduate Research Quality

This section identifies which among Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, and Digital Research Competency demonstrates the strongest unique predictive contribution to Graduate Research Quality. The determination is based primarily on the standardized beta coefficients (β) obtained from the multiple regression analysis, since these coefficients allow the relative contributions of predictors measured on different scales to be compared while statistically controlling for the other variables in the model. The results are presented in Table 7.

Table 7 Relative Predictive Contribution to Graduate Research Quality

| Predictor Variable | Standardized β | $t$ | $p$ | Rank | Interpretation |
|---|---|---|---|---|---|
| Critical Thinking | 0.418 | 8.24 | < 0.001 | 1 | Strongest Predictor |
| Digital Research Competency | 0.267 | 5.31 | < 0.001 | 2 | Second Strongest Predictor |
| GenAI Adoption | 0.142 | 2.87 | 0.004 | 3 | Significant Predictor |

*Note. The ranking is based on the magnitude of the statistically significant standardized beta coefficients obtained from the multiple regression model.*

As presented in Table 7, Critical Thinking emerged as the strongest predictor of Graduate Research Quality (β = 0.418, $t$ = 8.24, $p$ < 0.001), followed by Digital Research Competency (β = 0.267, $t$ = 5.31, $p$ < 0.001) and GenAI Adoption (β = 0.142, $t$ = 2.87, $p$ = 0.004). The result indicates that, when the effects of the other predictors are statistically controlled, Critical Thinking provides the greatest unique contribution to explaining variations in Graduate Research Quality. This finding suggests that the quality of graduate research depends more strongly on researchers' capacity to analyze information, evaluate evidence, formulate defensible inferences, interpret findings, and exercise reflective judgment than on the adoption of AI technology alone. This is consistent with Facione's (1990) conceptualization of critical thinking as purposeful and reasoned judgment involving interpretation, analysis, evaluation, and inference, which are fundamental intellectual

processes in rigorous scholarly inquiry. The finding is particularly important in an AI-enabled research environment because GenAI can rapidly generate information, explanations, and written content, but the researcher remains responsible for determining their accuracy, relevance, methodological appropriateness, and scholarly validity. Kasneci et al. (2023) similarly emphasized that large language models offer substantial academic opportunities but require human verification and critical oversight because their outputs may contain inaccuracies, biases, or fabricated information. The second-ranking contribution of Digital Research Competency further demonstrates that researchers require strong capabilities in information retrieval, source verification, digital tool utilization, research data management, and responsible digital practices to transform technological resources into credible scholarly outputs (Vuorikari et al., 2022). Although GenAI Adoption produced the smallest standardized coefficient, it remained statistically significant, indicating that AI adoption contributes to research quality but functions more appropriately as an enabling and supportive mechanism rather than the principal determinant of research excellence. Overall, the findings establish a clear empirical hierarchy in which Critical Thinking serves as the primary intellectual driver, Digital Research Competency functions as an enabling research capability, and GenAI Adoption operates as a technological support mechanism. This hierarchy provides an important empirical basis for the proposed AI-Assisted Research Excellence Framework, which should place human critical judgment at its core while integrating digital competency and responsible GenAI utilization to strengthen the rigor, originality, integrity, and overall quality of graduate research.

## 8. Proposed AI-Assisted Research Excellence Framework

This section presents the proposed AI-Assisted Research Excellence Framework, developed from the empirical findings of the study. The framework is intended to provide a systematic approach for integrating responsible Generative Artificial Intelligence adoption, critical thinking, digital research competency, and research quality assurance in graduate-level research. The regression results demonstrated that the three predictor variables collectively explained 55.1% of the variance in Graduate Research Quality ($R^2 = .551$), with Critical Thinking emerging as the strongest predictor ($\beta = .418$, $p < .001$), followed by Digital Research Competency ($\beta = .267$, $p < .001$) and GenAI Adoption ($\beta = .142$, $p = .004$). Based on these findings, the proposed framework places human intellectual judgment at the center of AI-assisted research while positioning digital competency and GenAI as complementary capabilities that support research excellence.

The proposed framework is organized into four interconnected components:

| Framework Component | Empirical Basis | Core Elements | Expected Contribution to Research Excellence |
|---|---|---|---|
| 1. Critical Scholarly Judgment | Strongest predictor, β = 0.418 | Analysis, evaluation, inference, interpretation, reflective judgment | Ensures that research decisions, evidence, AI-generated information, and conclusions are critically examined and intellectually defensible. |
| 2. Digital Research Capability | Second strongest predictor, β = 0.267 | Information retrieval, source verification, digital research tools, data management, digital ethics | Strengthens researchers' ability to locate, evaluate, manage, and use digital information and research technologies effectively and responsibly. |
| 3. Responsible GenAI Integration | Significant predictor, β = 0.142 | Usefulness, ease of use, research task integration, appropriate utilization, ethical and responsible use | Enables GenAI to enhance research efficiency while maintaining transparency, verification, academic integrity, and human oversight. |
| 4. Research Quality Assurance | Outcome of the integrated model | Conceptual and theoretical rigor, methodological rigor, analysis and interpretation, originality, ethical and academic integrity | Ensures that AI-assisted graduate research meets established standards of rigor, credibility, originality, ethics, and scholarly contribution. |

The framework proposes that Critical Scholarly Judgment should serve as its intellectual core because the empirical findings identified Critical Thinking as the strongest predictor of Graduate Research Quality. Graduate researchers must therefore remain responsible for analyzing evidence, questioning assumptions,

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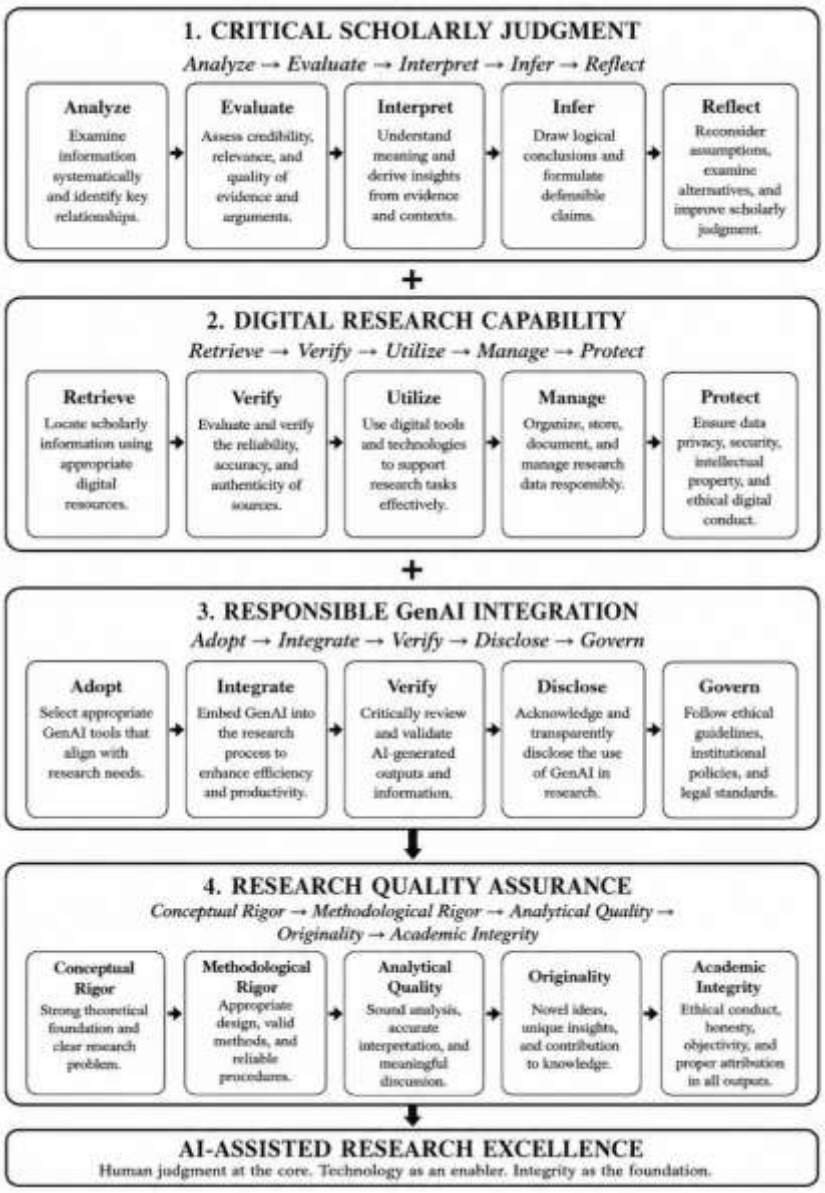
evaluating the credibility of AI-generated and conventional information, drawing defensible conclusions, and reflecting on their scholarly decisions. Digital Research Capability functions as the enabling competency that allows researchers to locate reliable information, verify sources, utilize appropriate research technologies, manage data systematically, and observe ethical standards in digital environments. Responsible GenAI Integration serves as the technological support component of the framework, emphasizing that GenAI should be employed to augment research activities rather than substitute for independent scholarly reasoning. Its comparatively smaller standardized coefficient indicates that AI adoption contributes to research quality, but its effectiveness depends substantially on the researcher's critical and digital competencies.

The framework ultimately directs these three components toward Research Quality Assurance, which ensures that AI-assisted research maintains conceptual and theoretical rigor, methodological soundness, analytical depth, originality, scholarly contribution, and ethical integrity. The empirical findings further indicate specific areas requiring attention: the relatively lower level of ethical and responsible GenAI use, the comparatively lower reflective judgment, weaker research data management, and the lower assessment of originality and scholarly contribution. These findings suggest that institutional strategies should extend beyond providing access to AI technologies and should include structured training in AI ethics, source verification, critical evaluation of AI-generated outputs, research data management, originality, and responsible disclosure of AI assistance.

Accordingly, the proposed AI-Assisted Research Excellence Framework may be expressed through the following developmental pathway:



The framework emphasizes that AI-Assisted Research Excellence is achieved not through greater dependence on artificial intelligence, but through the responsible integration of AI with human critical judgment, digital research competence, and rigorous quality assurance. It therefore positions the graduate researcher as the principal intellectual authority in the research process, while GenAI functions as an enabling and augmentative technology. At the institutional level, the framework can serve as a basis for developing graduate research policies, GenAI utilization guidelines, AI literacy programs, research competency training, ethical disclosure protocols, adviser and faculty development initiatives, and research quality assurance mechanisms. Through this integrated approach, graduate schools can encourage the productive use of emerging AI technologies while safeguarding originality, academic integrity, methodological rigor, scholarly accountability, and the fundamental role of human intellectual contribution in research.

# CONCLUSION AND RECOMMENDATION

## Conclusion

Based on the findings of the study, it is concluded that Generative Artificial Intelligence (GenAI) Adoption, Critical Thinking, and Digital Research Competency are important determinants of Graduate Research Quality. Graduate students demonstrated very high levels of GenAI Adoption, Critical Thinking, Digital Research Competency, and overall Graduate Research Quality, indicating substantial readiness to conduct research within an increasingly AI-enabled academic environment. However, specific areas requiring further development were identified, particularly ethical and responsible GenAI use, reflective judgment, research data management, and originality and scholarly contribution, suggesting that technological proficiency must be complemented by stronger ethical, cognitive, and research competencies. The significant positive relationships between all three predictor variables and Graduate Research Quality further demonstrate that improvements in GenAI adoption, critical thinking, and digital research competency are associated with improvements in the quality of graduate research. More importantly, the regression model revealed that these three factors collectively explained 55.1% of the variance in Graduate Research Quality, confirming their substantial combined contribution to research excellence. Among the predictors, Critical Thinking emerged as the strongest predictor ($\beta = .418$), followed by Digital Research Competency ($\beta = .267$) and GenAI Adoption ($\beta = .142$), demonstrating that human intellectual judgment remains more influential to research quality than technology adoption alone. The study therefore concludes that GenAI should be viewed as an augmentative research technology rather than a substitute for scholarly reasoning, and its contribution to graduate research is strengthened when researchers possess the ability to critically evaluate evidence, verify information, utilize digital resources competently, manage research data responsibly, and uphold academic integrity. Consequently, the proposed AI-Assisted Research Excellence Framework provides an evidence-based approach that places Critical Scholarly Judgment at its intellectual core, Digital Research Capability as an enabling competency, Responsible GenAI Integration as a technological support mechanism, and Research Quality Assurance as the pathway toward AI-Assisted Research Excellence. Ultimately, sustainable research excellence in the age of generative AI depends not on how extensively artificial intelligence is used, but on how critically, competently, ethically, and responsibly it is integrated into the research process while preserving human intellectual ownership, originality, methodological rigor, and scholarly accountability.

## Recommendations

Based on the findings and conclusions of the study, the following recommendations are proposed:

1. Graduate schools and higher education institutions should adopt and institutionalize the proposed AI-Assisted Research Excellence Framework as a guide for integrating GenAI into graduate research. Institutional policies should emphasize that GenAI serves as an assistive technology while preserving human intellectual judgment, originality, methodological rigor, transparency, and academic accountability.
2. Since Critical Thinking emerged as the strongest predictor of Graduate Research Quality, graduate research programs should strengthen activities that develop analysis, evaluation, inference, interpretation, and reflective judgment. Research courses, seminars, proposal defenses, and mentoring

activities should require students to critically evaluate evidence, justify methodological decisions, challenge assumptions, and independently verify AI-generated information rather than accepting automated outputs without scholarly scrutiny.

3. Graduate schools should strengthen Digital Research Competency, particularly research data management, which obtained the lowest assessment among its dimensions. Training should cover systematic data organization, secure storage and backup, data documentation, source verification, reference management, research software utilization, data privacy, cybersecurity, and responsible handling of research information.
4. Although GenAI Adoption was a significant predictor of Graduate Research Quality, institutions should prioritize responsible and ethical adoption rather than frequency of use alone. Clear institutional guidelines should be developed concerning acceptable GenAI applications, disclosure of AI assistance, verification of AI-generated information, confidentiality of research data, intellectual property, authorship, citation practices, and prohibited uses of AI in thesis, dissertation, and other graduate research outputs.
5. Particular attention should be given to strengthening ethical and responsible GenAI use, which emerged as the lowest-rated dimension of GenAI Adoption. Graduate students should be trained to verify AI-generated content against credible scholarly sources, identify fabricated references and unsupported claims, protect sensitive research information, disclose substantial AI assistance when required, and maintain responsibility for the accuracy and integrity of their final scholarly work.
6. Graduate research programs should strengthen originality and scholarly contribution, which obtained the lowest assessment under Graduate Research Quality. Students should be guided in identifying defensible research gaps, developing original research questions, generating independent interpretations, establishing theoretical and practical contributions, and distinguishing their intellectual contribution from AI-generated assistance.
7. Research advisers, panel members, and graduate faculty should be provided with continuing professional development on GenAI-assisted research supervision. Faculty development should include AI literacy, ethical evaluation of AI-assisted research, detection of questionable research practices, appropriate disclosure standards, source verification, and strategies for assessing students' authentic intellectual contributions.
8. Graduate schools may establish an AI-Assisted Research Quality Assurance protocol based on the sequence proposed in the framework: Analyze–Evaluate–Interpret–Infer–Reflect; Retrieve–Verify–Utilize–Manage–Protect; Adopt–Integrate–Verify–Disclose–Govern; and Conceptual Rigor–Methodological Rigor–Analytical Quality–Originality–Academic Integrity. These components may be incorporated into research evaluation rubrics, thesis and dissertation guidelines, research ethics procedures, and graduate research monitoring systems.
9. Future researchers should validate the proposed AI-Assisted Research Excellence Framework across different higher education institutions, graduate disciplines, and geographical settings. Future studies may also investigate other factors that could account for the remaining 44.9% of unexplained variance in Graduate Research Quality, including research self-efficacy, adviser support, research experience, institutional research culture, access to scholarly resources, AI literacy, and research motivation. Longitudinal, mixed-methods, or structural equation modeling approaches may further examine how these variables interact and how GenAI use influences research quality over time.

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