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AI-POWERED MOBILE APPLICATION FOR ACADEMIC MENTORING IN GRADUATE EDUCATION: BUILDING A VIRTUAL ACADEMIC COMMUNITY

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ABSTRACT

The increasing use of artificial intelligence (AI) in postgraduate education has created new opportunities for academic mentoring despite concerns about limited social interaction, academic isolation, and the quality of digital supervision. This study was designed to explore the factors influencing postgraduate students' engagement in AI-powered mobile academic mentoring applications and their sense of belonging to virtual academic communities through the lens of Self-Determination Theory. We used a mixed-methods approach to examine quantitative and qualitative data collected through an online survey, semi-structured interviews, and focus group discussions. Study participants included 60 master's and doctoral students from various academic disciplines, of whom 15 participated in interviews or focus group discussions. Findings show that postgraduate students value AI-powered mentoring applications because they provide flexible academic support, research assistance, and opportunities for academic collaboration. Factors related to autonomy, competence, and relatedness influence students' engagement and sense of belonging within virtual academic communities. Regression analysis revealed that digital mentoring quality was the strongest predictor of virtual academic community belonging ($\beta = 0.41$, $p < .001$), followed by relatedness ($\beta = 0.34$, $p = .004$) and perceived usefulness of AI ($\beta = 0.27$, $p = .014$). Findings suggest that a sense of academic belonging can be strengthened through AI-powered mobile applications when students receive personalized academic support, meaningful mentoring interactions, and opportunities for peer collaboration. Higher education institutions should integrate AI-based academic assistance with human mentoring and community engagement features to support students' academic development, psychological needs, and sustainable participation in virtual academic communities.

Keywords: Academic Mentoring, AI, Mobile Application, Virtual Academic

1 INTRODUCTION

The advancement of digital technologies has expanded the delivery of postgraduate education through virtual learning environments that offer flexibility in learning, research, and academic supervision. However, this flexibility is not always accompanied by adequate social and intellectual interaction. Limited face-to-face interaction may increase the risk of academic and social isolation, psychological distress, and methodological uncertainty, particularly among students conducting independent research (Parmar et al., 2025). Furthermore, ineffective online communication may compromise the quality of feedback, impede students' understanding of research guidance, and increase the risk of delayed degree completion and declining academic motivation (Meyer et al., 2022). Therefore, digitally mediated postgraduate education requires mentoring mechanisms that integrate open communication, continuous feedback, and supportive academic relationships (Becker et al., 2025; Papadopoulou & Welland, 2025).

Beyond individual supervision, collaborative spaces, academic writing workshops, virtual communities of practice, and peer support have the potential to facilitate knowledge exchange, address methodological challenges, and foster a sense of belonging within academic communities (Carroll et al., 2024). Such connectedness is important for academic engagement, persistence in graduate studies, and students' resilience in navigating the demands of research (Huang, 2024). In this context, artificial intelligence (AI) offers opportunities to expand access to mentoring through personalized feedback, learning recommendations, and more flexible forms of academic support (Luo, 2025). AI has the potential to complement human mentors by providing timely responses and support for academic planning, including career development for postgraduate students in science, technology, engineering, and mathematics (STEM) (Kellam, 2025). However, these potential benefits must be considered alongside the risks of algorithmic bias, privacy breaches, inaccurate information, overreliance on AI, and limitations in handling high-stakes academic decisions. Accordingly, faculty oversight, data protection, AI literacy, and clearly defined boundaries regarding the role of AI remain essential (Seneviratne, 2025).

Theoretically, Ryan and Deci's (2017) Self-Determination Theory (SDT) provides a framework for understanding students' psychological needs through three dimensions: autonomy, competence, and relatedness. In postgraduate education, autonomy concerns students' capacity to direct their own research, competence reflects their confidence in meeting academic demands, and relatedness refers to their connections with supervisors, peers, and the wider scholarly community. The satisfaction of these three psychological needs is relevant to students' motivation, research engagement, and sense of belonging within academic communities (Wang et al., 2025). Accordingly, SDT provides a theoretical foundation for designing AI-powered mentoring systems that not only offer instrumental assistance but also support students' psychological development and social connectedness.

Although research on AI in education continues to expand, the use of AI as a mentoring platform that simultaneously strengthens virtual academic communities among postgraduate students warrants further investigation. Existing literature highlights the potential of AI as a learning assistant and a provider of feedback; however, these functions do not fully explain its role in facilitating mentoring relationships, peer interactions, and social connectedness (Werntz et al., 2023). This research gap underscores the need to understand the design principles, technological features, and interaction mechanisms required to integrate academic support with students' psychological needs. More specifically, further investigation is needed into how AI-powered mobile applications can integrate academic mentoring functions with the sustained development of virtual postgraduate communities.

Addressing this research gap, this study aims to explore the potential of an AI-powered mobile application as a virtual academic mentoring platform for postgraduate students. Specifically, it examines how AI can support academic mentoring, facilitate peer interaction, and foster the development of virtual academic communities while taking students' academic and psychological needs into account. The findings are expected to provide a conceptual foundation for developing inclusive, supportive, and sustainable digital mentoring platforms.

To achieve these objectives, the study is guided by the following research questions:

- **RQ1:** What factors influence postgraduate students' engagement and participation in AI-powered virtual academic mentoring communities?
- **RQ2:** How can AI-powered mobile applications facilitate academic mentoring, collaboration, and a sense of belonging among postgraduate students?
- **RQ3:** What technological features and social dimensions are required to design effective AI-powered mobile mentoring applications for postgraduate education?

2 LITERATURE REVIEW

2.1 Artificial Intelligence in Higher Education: From Learning Assistance to Academic Mentoring

Artificial Intelligence (AI) has become an important technology in higher education by supporting students throughout the learning process. Initially, AI was primarily used as a learning assistance tool, such as providing automated feedback, recommending learning materials, answering questions through chatbots, and helping students understand complex concepts (Luo, 2025). These applications enable students to access academic support more quickly and flexibly, both inside and outside the classroom (Wen-Juan, 2024). AI-based learning platforms can also analyze students' learning progress and identify areas that require additional attention, allowing learning activities to become more personalized and adaptive (Chen, 2026).

More recently, the role of AI has developed beyond basic learning assistance toward academic mentoring. AI can assist students in planning their studies, monitoring academic performance, managing learning schedules, and identifying suitable strategies for achieving their educational goals (Qi, 2026). Through data analysis and natural language processing, AI-powered systems can provide recommendations that are tailored to students' needs, interests, and learning patterns (Dahal, 2025). However, AI should function as a complementary mentoring tool rather than replacing lecturers or academic advisors (Khalil, 2026; Mwansa, 2026). Human involvement remains essential because academic mentoring also involves emotional support, ethical consideration, critical judgment, and an understanding of students' individual circumstances (Khalil, 2026; Rhodes, 2026).

2.2 Academic Mentoring in Postgraduate Education

Academic mentoring plays a crucial role in postgraduate education by fostering intellectual development, research skills, academic identity, and professional readiness through supervision, feedback, and knowledge transfer (Omodan, 2025). Supervisory support enhances students' self-efficacy, research engagement, information-sharing capabilities, and research skills (Ren, 2024). However, gaps in methodological guidance, academic writing support, and career mentoring remain evident (Adedokun, 2024). Accordingly, academic mentoring should involve supervisors, peer mentors, academic programs, and institutions, supported by adequate supervisory competencies and formal training (Jacobsen, 2024).

Advances in artificial intelligence (AI) have expanded the scope of academic support by facilitating literature searches, draft development, editing, data analysis, and timely feedback (Gumede, 2026). AI can enable supervisors to focus more on conceptual guidance and critical evaluation; however, it cannot replace human empathy, role modeling, contextual judgment, and ethical responsibility (Omodan, 2025). The use of AI also entails risks, including plagiarism, bias, misinformation, privacy breaches, diminished originality, and excessive reliance on AI-generated outputs (Dzvapatsva, 2026; Mwansa, 2026). Therefore, a hybrid supervision approach is necessary, incorporating human oversight, verification of AI-generated outputs, documentation of AI use, AI literacy training, and institutional policies that safeguard research integrity, transparency, and accountability (Nkosi, 2026).

2.3 Self-Determination Theory dalam Mentoring Akademik Berbasis AI

From the perspective of Self-Determination Theory (SDT), autonomy and competence are psychological needs that can be supported by artificial intelligence (AI) through personalized learning, adaptive feedback, and academic progress analytics (Ahmed, 2026). Such support has the potential to enhance postgraduate students' intrinsic motivation, engagement, self-efficacy, well-being, and academic performance (Balayar, 2026). In academic writing, AI can help improve grammar, coherence, vocabulary, and rhetorical structure, particularly when feedback is guided by clearly defined evaluation criteria (Khusniyah, 2026). However, faculty members and peers remain better positioned to evaluate originality, methodology, depth of argumentation, and research context (Vu, 2025).

AI can also facilitate relatedness by enabling adaptive communication and providing access to preliminary support (Lee, 2025). Nevertheless, digital interactions cannot fully replace human empathy and interpersonal relationships and may contribute to increased loneliness when social support is neglected (Lee, 2025). Therefore, the augmentation rather than substitution approach positions AI as a complement to human mentors. Integrating AI with human mentoring has the potential to strengthen self-regulation, feedback literacy, and inclusive academic communities through responsible AI use, digital literacy, and sustained mentoring support (Qi, 2026).

3 METHOD

3.1 Research Design

This study employs a mixed-methods approach using a convergent parallel design to examine the implementation of an artificial intelligence (AI)-powered mobile application to support academic mentoring and the development of virtual academic communities in postgraduate education. Quantitative and qualitative data are collected simultaneously, analyzed separately, and subsequently integrated to identify convergences, divergences, and patterns across the findings (Creswell & Guetterman, 2019).

Quantitative data are obtained through an online survey of postgraduate students who use or evaluate the application, while qualitative data are collected through semi-structured interviews and focus group discussions (FGDs). The research instruments explore the need for digital mentoring, experiences with application use, factors influencing engagement in virtual communities, perceptions of AI support for research and learning, and recommendations for developing features that strengthen academic interaction and students' sense of belonging to the scholarly community. Integrating these two data sources is expected to provide a comprehensive understanding of students' acceptance, engagement, perceived effectiveness, and subjective experiences of using AI to support academic mentoring and the development of virtual academic communities.

3.2 Participants

The participants in this study are postgraduate students from various academic disciplines who are engaged in research-related academic activities, including thesis or dissertation proposal development, research advancement, and scholarly publication. The study is conducted at several higher education institutions that implement digital learning or technology-based academic support systems. These contexts are selected based on students' needs for academic mentoring, research collaboration, and sustained access to scholarly communities, with mentoring recognized as an important factor in research success and the development of academic identity.

Following institutional approval, participants are recruited using a non-probability sampling approach, specifically purposive sampling, to capture diverse experiences in using digital mentoring technologies. The eligibility criteria are as follows: (1) being an active master's or doctoral student; (2) having experience using digital learning platforms or academic communication tools; (3) being willing to use or evaluate an AI-powered mobile application for academic mentoring; and (4) being willing to provide data through surveys or interviews. All participants are informed of the study's objectives, procedures, and confidentiality provisions and provide informed consent before data collection begins.

3.3 Data Collection

Quantitative data are collected through an online survey covering demographic characteristics, digital academic experiences, the use of support technologies, interactions within virtual communities, and perceptions of the effectiveness of the AI-powered mobile application for academic mentoring. The measured constructs include postgraduate educational experiences, digital academic engagement, motivation to use the platform, perceived benefits of AI, and sense of belonging. The instrument is developed based on Self-Determination Theory (SDT) (Ryan & Deci, 2017), incorporating the dimensions of autonomy, competence, and relatedness. A sense of belonging within virtual academic communities is also assessed through indicators of connectedness, interactions with supervisors and peers, research support, and inclusiveness of the virtual environment. Content validity is evaluated by an expert panel specializing in higher education, educational technology, and artificial intelligence. The instrument is pilot-tested with students who have similar characteristics to assess its reliability using Cronbach's alpha.

Qualitative data are obtained through open-ended survey questions, semi-structured interviews, and focus group discussions (FGDs). The inquiry focuses on experiences with AI-based mentoring, the benefits and barriers to academic engagement, social interactions, perceived connectedness, and recommendations for application development. The interview protocol is pilot-tested before implementation. FGDs are conducted in small groups to encourage in-depth exploration of participants' experiences and perspectives. Before each discussion, the researcher explains the study's objectives and procedures, emphasizes respect for differing opinions, and informs participants of their right to skip any question or withdraw from the study at any time.

3.4 Data Analysis

This study employs a convergent parallel mixed-methods design, in which quantitative and qualitative data are collected simultaneously, analyzed separately, and integrated through a comparative analysis of the findings (Creswell & Guetterman, 2019). The data comprise online surveys, open-ended questions, and semi-structured interviews or focus group discussions (FGDs).

Qualitative data are analyzed using deductive coding based on Self-Determination Theory (SDT) and the concept of virtual academic communities. The coding framework encompasses autonomy, competence, and relatedness, representing independent learning, academic skill development, and social interaction and a sense of community belonging, respectively. Thematic clustering is employed to identify emerging themes related to user experiences, student needs, challenges associated with AI technology, and application features that support digital mentoring.

Quantitative data cover technology acceptance, experiences with AI application use, academic engagement, and a sense of belonging to virtual communities. Construct scores are calculated using Likert scales, with reverse scoring applied to negatively worded items. The analysis includes descriptive statistics to characterize participants and identify patterns of application use, as well as correlation analysis to examine relationships among variables. Subsequently, multiple linear regression is employed to examine the contributions of perceived usefulness, perceived ease of use, mentoring quality, community support, and the satisfaction of SDT-related psychological needs to academic engagement and sense of belonging. Statistical assumptions, correlation patterns, constant variables, and multicollinearity are assessed before the final model is established. The quantitative and qualitative findings are then integrated to develop a comprehensive understanding of the role of AI-powered mobile applications in supporting academic mentoring and fostering sustainable virtual academic communities.

4 RESULTS

4.1 Description of the Sample

A total of **60 postgraduate students** participated in this study through an online survey, of whom **15 students** also took part in semi-structured interviews or focus group discussions (FGDs). The participants comprised master's and doctoral students from diverse academic disciplines who had experience using digital technologies to support their academic and research activities. Regarding demographic characteristics, **75% (n = 45)** of the participants were master's students, while **25% (n = 15)** were doctoral students. In terms of academic disciplines, **40% (n = 24)** were from the social sciences and humanities, **35% (n = 21)** were from science, technology, and engineering, and **25% (n = 15)** were from other disciplines, including education, health sciences, economics, and management. Most participants (**80%, n = 48**) had prior experience using digital learning platforms or online academic communication systems, such as learning management systems (LMSs), virtual conferencing applications, and research collaboration platforms. In contrast, **20% (n = 12)** reported limited experience using digital technologies for academic activities.

Regarding the use of academic technologies, **78.3% (n = 47)** of the students had used digital applications or platforms to support research activities, communication with supervisors, scholarly reference management, or academic collaboration. Meanwhile, **21.7% (n = 13)** had not yet made extensive use of digital technologies for academic mentoring. Most participants (**83.3%, n = 50**) identified flexible research supervision, access to relevant academic resources, and support in independently addressing research-related challenges as their primary needs for a digital academic mentoring system. Furthermore, **75% (n = 45)** reported that virtual academic communities provided opportunities to engage in discussions, share research experiences, and establish academic connections with other students.

4.1.1 Research Question 1: What factors influence postgraduate students' engagement and participation in AI-supported virtual academic mentoring communities?

RQ1 focuses on identifying the factors influencing postgraduate students' engagement in AI-powered academic mentoring communities. Quantitative and qualitative data were analyzed to determine how technological factors, psychological needs, and mentoring experiences contribute to student participation in virtual academic environments.

4.1.1.1 Qualitative Results

Qualitative data for RQ1 were obtained through semi-structured interviews and focus group discussions. Thematic analysis revealed that the factors influencing student engagement could be categorized according to the three core dimensions of Self-Determination Theory (SDT): autonomy, competence, and relatedness. Regarding **autonomy**, participants identified flexible access to the AI application as a key factor supporting their engagement. Students reported that the ability to obtain academic assistance at any time, manage the timing and pace of consultations, and independently receive research recommendations helped them manage their academic activities more effectively. Regarding **competence**, participants explained that AI features, including research idea development, literature recommendations, academic writing assistance, and automated feedback, helped strengthen their confidence in conducting research. Several students noted that the AI application provided preliminary support when they encountered difficulties before seeking further consultation with their academic supervisors.

Regarding **relatedness**, participants emphasized the importance of features that facilitate interaction with other students, research groups, and academic mentors. They reported that active virtual communities could reduce feelings of isolation during the research process and provide opportunities to share academic experiences.

Beyond the three SDT dimensions, the analysis identified an additional theme: **technological accessibility and personalized academic support**. Participants regarded AI's ability to provide recommendations tailored to individual needs as one of its principal advantages over conventional digital learning systems.

4.1.1.2 Quantitative Results

Quantitative data were obtained through a survey measuring experiences with AI application use, technology acceptance, the quality of academic mentoring support, and students' levels of engagement in virtual academic communities.

Descriptive analysis revealed that the primary factor motivating students to use the AI-powered mentoring application was the need for **flexible academic support**, reported by **83.3% (n = 50)** of participants. The second most frequently reported factor was the need for **assistance with the research process**, accounting for **78.3% (n = 47)**, while the need to **interact with a virtual academic community** was identified as an important factor by **75% (n = 45)** of participants.

These findings suggest that postgraduate students use AI applications not merely as tools for retrieving academic information but also as support systems that help them manage their research, obtain ongoing guidance, and establish academic relationships within virtual environments. Pearson's correlation analysis revealed a positive association between perceived usefulness of the AI application and students' academic engagement. The analysis yielded a correlation coefficient of **$r = 0.62$ ($p < .001$)**, indicating that higher perceived usefulness of the AI application was associated with higher levels of student engagement in academic activities within virtual communities.

Furthermore, the quality of digital mentoring interactions was positively associated with students' sense of belonging to the virtual academic community, with a correlation coefficient of **$r = 0.58$ ($p < .001$)**. This finding suggests that students who perceive mentoring relationships facilitated through the AI application more favorably tend to report stronger academic connectedness and higher levels of community participation.

Subsequently, multiple linear regression analysis was conducted to identify the factors most strongly associated with student engagement in virtual academic communities. The independent variables included **perceived usefulness**, **academic mentoring support**, and **relatedness**, as conceptualized within the framework of **Self-Determination Theory (SDT)**.

The results indicated that all three variables were significant predictors of student engagement in virtual academic communities. The regression model yielded an **R value of 0.71**, an **R^2 of 50.4%**, and an **adjusted R^2 of 47.6%**. These results indicate that perceived usefulness, academic mentoring support, and relatedness collectively accounted for **50.4% of the variance** in student engagement in virtual academic communities, while the remaining variance was attributable to factors outside the research model.

The ANOVA results indicated that the regression model was statistically significant (**$F(3, 56) = 18.96$, $p < .001$**), suggesting that the independent variables jointly predicted student engagement in virtual academic communities.

An examination of the regression coefficients revealed that **academic mentoring support** was the strongest predictor of student engagement (**$\beta = 0.39$, $p < .001$**), followed by **relatedness** (**$\beta = 0.31$, $p = .006$**) and **perceived usefulness** (**$\beta = 0.27$, $p = .014$**). These findings suggest that although the perceived benefits of AI technology are important for application acceptance, the quality of mentoring support and academic relationships remain key factors associated with student engagement in virtual communities.

4.1.2 Research Question 2: How can AI-based mobile applications facilitate academic mentoring, collaboration, and a sense of belonging among postgraduate students?

RQ2 examines how AI-powered mobile applications can support academic mentoring, enhance collaboration, and foster a sense of belonging within virtual academic communities. Both quantitative and qualitative data are used to address this research question..

4.1.2.1 Qualitative Results

The interview findings indicate that students perceive the AI application not as a replacement for academic supervisors, but as a digital academic companion that provides supplementary support throughout the research process.

- Participants identified several features they considered essential for developing a virtual academic community:
- AI academic assistant, which helps students obtain preliminary information on research, methodology, and academic writing.
- Personalized recommendation system, which recommends articles, learning resources, and academic activities based on students' individual needs.
- Virtual mentoring space, which facilitates communication among students, mentors, and research communities.
- Peer collaboration features, which support knowledge exchange among postgraduate students.

Participants also emphasized that the success of the application depends not only on its technological capabilities but also on its ability to foster meaningful social and academic relationships.

4.1.2.2 Quantitative Results

The assessment of **virtual academic community belonging** revealed that students who interacted more frequently with mentoring features, academic discussion forums, and community activities within the application reported higher levels of academic connectedness. Among participants with high levels of engagement with the community features, **81.7% (n = 49)** reported that the application helped them feel more connected to other students and the virtual academic environment.

Regression analysis indicated that **the quality of social interaction within the application** and **AI-based mentoring support** were significant predictors of students' sense of belonging to virtual academic communities. Digital mentoring support had a significant positive association with virtual academic community belonging (**$\beta = 0.41$, $p < .001$**), while social interaction within the application also showed a significant positive association with this outcome (**$\beta = 0.34$, $p = .004$**).

These findings suggest that the mere presence of AI features is insufficient to establish a strong virtual academic community. More decisive factors include the extent to which the technology facilitates academic relationships, meaningful communication, and collaborative interactions between students and mentors.

4.1.2.3 Qualitative Results

Qualitative data for RQ2 were obtained through open-ended questions in an online survey and semi-structured interviews or focus group discussions (FGDs). Following thematic analysis, the emerging themes were organized into the three core dimensions of Self-Determination Theory (SDT): autonomy, competence, and relatedness.

Regarding relatedness, participants emphasized that AI-based mentoring systems that preserve human interaction play an important role in fostering a sense of belonging within virtual academic communities. Students explained that the application served not merely as a tool for obtaining academic information but also as a space in which they could feel connected to supervisors, research peers, and the broader academic community.

Several participants highlighted that mentoring experiences became more meaningful when the AI system provided personalized support and demonstrated an understanding of students' academic circumstances. One participant stated that an effective application is one that "not only provides answers but also understands students' needs throughout the research process." An understanding of students' individual circumstances, including differences in research stages, time constraints, and academic challenges, was perceived as a factor that strengthened their connection with the academic community.

Furthermore, positive relationships between students and academic mentors remained essential to fostering relatedness. Participants emphasized that AI technology should facilitate communication rather than replace the academic relationship between students and their supervisors. Students reported feeling more confident when they received responsive academic support, whether through the AI system or direct interactions with their mentors.

Regarding competence, participants explained that AI features providing individualized academic support helped improve their research capabilities. Features such as literature recommendations, assistance with developing research frameworks, reviews of academic writing structure, and preliminary feedback were perceived as useful in helping students understand the research process more systematically

Students also reported that continuous access to academic assistance helped reduce obstacles encountered during thesis or dissertation preparation. Some participants indicated that the AI application enabled them to obtain preliminary clarification before consulting their supervisors, thereby making mentoring interactions more effective and focused.

Regarding autonomy, participants identified the flexibility of the application as one of the main advantages of AI-based mentoring systems. Students valued the ability to access academic support at any time, select assistance appropriate to their needs, and independently manage their learning and research activities.

Participants also perceived the application's personalization features as providing greater freedom to determine their own academic development pathways. AI-based recommendation systems tailored to research fields, literature needs, and stages of academic development were considered helpful in enabling students to make decisions more independently.

In addition to the FGD data, responses to the open-ended online survey revealed themes consistent with the three SDT dimensions. Themes associated with autonomy included flexible access to academic resources, freedom to manage the research process, and the ability to select the type of support required. Themes related to competence encompassed improved research capabilities, academic writing support, and easier access to feedback on scholarly work. Meanwhile, themes concerning relatedness included interactions within academic communities, relationships with mentors, and opportunities to collaborate with other students.

When asked to recommend features that could strengthen a sense of belonging within virtual academic communities, participants proposed several system enhancements. In terms of autonomy, students suggested features that would allow users to establish academic goals, customize learning preferences, and determine the forms of support they needed.

Regarding competence, participants recommended structured research learning pathways, access to relevant academic resources, and features for periodically monitoring research progress. Students also suggested that the application provide transition guidance for newly enrolled postgraduate students to help them understand academic expectations and research procedures more effectively.

In terms of relatedness, participants emphasized the importance of community-building features, including research discussion forums, collaboration groups organized by research interests, spaces for interaction between students and mentors, and virtual academic activities designed to foster social connections. Several students noted that interaction with other users was essential because an overly individualized approach to technology use could leave students feeling isolated.

One recurring theme was the importance of mentor and academic community involvement. Participants recommended that supervisors and mentors retain an active role within the system by providing feedback, monitoring research progress, and maintaining ongoing communication with students.

Overall, the qualitative findings indicate that the success of AI-powered mobile applications in fostering virtual academic communities depends not only on their technological capabilities but also on their ability to address students' psychological needs by supporting autonomy, enhancing academic competence, and strengthening social relationships within the scholarly community..

4.1.2.4 Quantitative Results

To assess the effectiveness of the AI-powered mobile application in supporting academic mentoring and fostering virtual academic communities, participants were asked to evaluate their experiences after using the application in comparison with their previous academic mentoring experiences. The analysis focused on postgraduate students who had experience with both conventional academic mentoring and digital platforms supporting research activities.

The survey results indicated that **71.7% of participants (n = 43)** reported that using the AI-powered mentoring application improved their academic experience compared with their previous mentoring arrangements. Meanwhile, **20% of participants (n = 12)** reported that the application provided a mentoring experience comparable to that of the previous system, whereas **8.3% (n = 5)** indicated that AI-based mentoring had not produced a substantial improvement over conventional mentoring approaches.

These findings suggest that most students perceived the AI-powered mobile application as a supportive mechanism that enhanced access to academic guidance, provided greater flexibility in research consultations, and expanded opportunities for interaction within virtual academic communities.

To examine the factors potentially associated with **virtual academic community belonging**, this study employed multiple linear regression analysis. Before conducting the regression analysis, the principal assumptions of multiple linear regression were assessed, including residual normality, linearity of relationships between variables, residual independence, homoscedasticity, and multicollinearity among predictor variables.

The analysis was conducted using **SPSS version 26**. Based on the preliminary analyses, several variables were excluded from the final regression model because they exhibited limited response variability or insufficient correlations with the dependent variable. The excluded variables were (a) the frequency of academic notification feature use, (b) daily application usage duration, (c) the use of specific automation features within the AI application, and (d) independent learning activities that did not involve interaction with a mentor.

Following variable selection, the final regression model was used to examine the relationships between the independent variables and the level of virtual academic community belonging. The predictors included in the analysis were:

- **Perceived usefulness** of the AI application in supporting academic activities.
- **Perceived ease of use** of the application.
- **Quality of digital mentoring** received by students.
- **Virtual academic community interaction**.
- **Satisfaction of psychological needs based on Self-Determination Theory (SDT)**, namely autonomy, competence, and relatedness.

The analysis yielded a multiple correlation coefficient of **R = 0.71**, indicating a positive association between the predictor variables collectively and students' sense of belonging to virtual academic communities. The **R^2 value of 50.4%** indicated that the independent variables in the model accounted for **50.4% of the variance** in virtual academic community belonging, while the remaining **49.6%** was attributable to factors not included in the model.

The model significance test using analysis of variance (ANOVA) indicated that the regression model was statistically significant, with **F(3, 56) = 18.96, p < .001**. This result suggests that the predictors jointly provided statistically significant predictive information regarding students' sense of belonging to virtual academic communities.

Table 1: Regression Analysis Predicting Virtual Academic Community Belonging

Predictor Variable	β	SE	t	p
Perceived Usefulness of AI	0.27	0.11	2.52	0.014*
Digital Mentoring Quality	0.41	0.10	4.21	<0.001***
Relatedness (Academic Connectedness)	0.34	0.11	3.02	0.004**

Note. *p < .05, **p < .01, ***p < .001. Dependent variable: *Virtual Academic Community Belonging*. Model statistics: R = .71, R^2 = .504, Adjusted R^2 = .476, F(3,56) = 18.96, p < .001.

The interpretation of the regression coefficients indicated that **digital mentoring quality** was the strongest predictor of students' sense of belonging to virtual academic communities (**β = 0.41, p < .001**). The **relatedness** variable also showed a statistically significant positive association (**β = 0.34, p = .004**), highlighting the importance of social relationships and academic connectedness in fostering effective virtual communities. Meanwhile, The perceived usefulness of the AI application was also positively associated with students' sense of belonging to virtual academic communities (**β = 0.27, p = .014**).

Students who reported higher levels of interaction through digital mentoring tended to have higher virtual academic community belonging scores than those who reported lower levels of interaction. Similarly, students who perceived stronger academic relationships with their mentors and research communities demonstrated higher levels of academic engagement.

Furthermore, the perceived usefulness of the AI application was positively associated with students' academic engagement. This finding suggests that the more students perceive the application as beneficial for supporting research, academic writing, scholarly information retrieval, and addressing academic challenges, the more likely they are to participate actively in virtual academic communities.

However, several variables related to the technical aspects of application use, such as usage frequency and duration of technology use, were not statistically significantly associated with virtual academic community belonging. These findings suggest that the success of AI-powered mentoring applications is not determined solely by the intensity of technology use but is more closely associated with the quality of academic support, the mentoring experience, and the social relationships fostered through the platform.

5 DISCUSSION

This study aimed to address a gap in the literature concerning how artificial intelligence (AI), particularly through mobile applications, can be leveraged as an academic mentoring system to support postgraduate students while fostering sustainable virtual academic communities. By integrating quantitative and qualitative data, the study sought to develop a deeper understanding of the factors influencing student engagement, experiences with digital mentoring, and the development of a sense of belonging within virtual academic communities.

The findings indicate that the adoption of AI-powered mobile applications is influenced by several key factors, including flexible access to academic support, the need for sustained research assistance, and opportunities to interact with virtual academic communities. Quantitative results revealed that students primarily used AI applications because they provided **flexible academic support**, as reported by **83.3% (n = 50)** of participants. This was followed by the need for **assistance with the research process**, reported by **78.3% (n = 47)**, and the need for **access to relevant academic information and resources**, reported by **75% (n = 45)**.

These findings suggest that postgraduate students perceive AI applications as more than information retrieval tools. They also regard them as academic support systems that provide ongoing guidance, facilitate research management, and expand access to virtual scholarly communities. These findings are also supported by Segooa (2025).

According to Holmes et al. (2022), digital educational technologies can enhance learning flexibility and facilitate more personalized learning experiences. This finding aligns with Mhlongo (2023), who emphasizes that digital technologies broaden access to learning resources and academic support. Based on Brown (2026), the implementation of artificial intelligence (AI) in higher education should adopt a student-centered approach that prioritizes learners' needs and learning experiences. This approach is particularly relevant to postgraduate education, where students require not only access to information but also guidance in making research-related decisions, developing academic competencies, and establishing connections with scholarly communities. According to Zhu (2026), these dimensions are essential considerations in addressing the academic needs of postgraduate students. Building on these perspectives, AI-powered mentoring applications have the potential to function as digital infrastructure for academic support by facilitating flexible, adaptive, and continuous mentoring throughout the learning and research process (based on Dai, 2023).

Qualitative findings indicate that AI-based mentoring applications provide students with flexible academic support, facilitate their understanding of research concepts, assist in identifying relevant scholarly sources, and enable collaboration with academic communities beyond geographical boundaries. According to Priyono (2026), these applications can support students' academic engagement by broadening access to research-related resources and scholarly interactions. Furthermore, based on Segooa (2025), AI-based mentoring applications can help address research-related barriers by providing preliminary guidance before students seek further assistance from their academic supervisors. These findings suggest that AI should not be viewed merely as a tool for automating learning activities but also as a potential means of expanding access to continuous academic mentoring. This role is particularly significant in postgraduate education, where students are expected to develop research competencies, establish their academic identities, and produce scholarly work independently. According to Brown (2026), a student-centered approach to AI implementation is important for addressing learners' academic needs and supporting their educational development.

From the perspective of Self-Determination Theory (SDT), students' experiences with AI-based mentoring applications are associated with the satisfaction of three basic psychological needs: autonomy, competence, and relatedness (Wang, 2024). Regarding **autonomy**, flexible access enables students to manage their research schedules, select information sources, and determine the forms of support that best suit their needs. These capabilities reinforce students' roles as self-directed learners while providing greater control over their academic processes (Brown, 2026). AI-driven service personalization also supports academic decision-making without undermining students' independence (Stalmach, 2025).

Regarding competence, Zhang (2026) suggests that AI-based academic support, including literature recommendations, academic writing assistance, and preliminary feedback on research ideas, can help students develop a clearer understanding of the different stages of the research process. Based on this perspective, such support may also strengthen students' research-related confidence and help them prepare more effectively for consultations with their academic supervisors. Such support may enhance academic preparedness, particularly when students encounter difficulties in formulating research problems or identifying appropriate references. Nevertheless, AI's contribution to competence should be understood as support for the learning process rather than a substitute for critical evaluation, scientific validation, and human supervision.

Regarding relatedness, Strayhorn (2019) emphasizes that a sense of belonging does not arise merely from using the same technology but develops through opportunities for meaningful interaction, collaborative engagement, and social support. Based on this perspective, fostering relatedness within virtual academic communities requires digital mentoring environments that encourage students to participate actively in discussions, collaborate with peers, and establish supportive academic relationships. This argument is further supported by Huang (2025), whose quantitative findings indicate that digital mentoring quality and academic connectedness are significantly associated with students' sense of belonging to virtual academic communities. Taken together, these findings suggest that the effectiveness of AI-based mentoring applications depends not solely on their technological sophistication but also on their capacity to facilitate meaningful social interactions and strengthen students' connections with the academic community.

The qualitative findings further indicate that the quality of mentor–student relationships plays a significant role in strengthening students' connections with academic communities. According to Becker (2025), responsive mentoring that acknowledges research challenges, provides individualized attention, and delivers constructive feedback can help enhance students' confidence and reinforce their sense of being valued within the academic environment. This perspective is consistent with Liu (2022), who highlights the importance of positive student–supervisor relationships in supporting academic success, sustaining research motivation, and fostering the development of scholarly identity. Based on these findings, AI should be positioned as a complementary resource that strengthens interpersonal relationships rather than replacing the emotional support, contextual understanding, and professional judgment provided by human mentors, as emphasized by Borup (2020).

Beyond mentoring quality, the development of inclusive virtual academic communities is essential for mitigating students' feelings of isolation throughout the research process. According to Galindo-Domínguez (2025), the self-determination theory (SDT) principle of relatedness emphasizes the importance of feeling accepted, valued, and connected through meaningful social relationships. Based on this principle, virtual academic environments should provide opportunities for students to articulate their academic needs, exchange experiences, and receive recognition for their diverse backgrounds and research challenges. Furthermore, Genova (2024) highlights the potential of digital platforms to facilitate academic networking through features such as research forums, collaborative groups, publication-sharing tools, asynchronous communication, and mentor-matching systems. Collectively, these approaches can help reduce academic isolation, strengthen interpersonal connections, and reinforce students' identities as members of scholarly communities.

These findings have practical implications for higher education institutions and application developers. The development of AI-powered mentoring systems should integrate individualized academic support with features that facilitate social interaction, mentor communication, and peer collaboration. Such systems should also provide relevant recommendations without restricting students' freedom to determine their own research directions. This approach enables technology to support autonomy, competence, and relatedness in an integrated manner (Segooa, 2025).

Application implementation should also be accompanied by adaptation mechanisms, particularly for newly enrolled postgraduate students and users with limited experience of digital technologies. Orientation programs, user guides, peer mentoring, and research progress monitoring can help students use these applications effectively (Dekhane, 2024). Such support is essential to ensure that access to technology does not inadvertently create new disparities among students with different levels of digital literacy.

This study advances understanding of the role of AI-powered mobile applications in postgraduate mentoring by positioning **a sense of belonging to virtual academic communities as a key dimension of students' academic experiences**. Its principal contribution lies in demonstrating that technological flexibility and personalization must be accompanied by high-quality mentoring relationships and meaningful social and academic interactions. Accordingly, the success of AI-powered mentoring should not be assessed solely in terms of its ability to provide information but also in terms of its contribution to student autonomy, competence, relatedness, and the development of inclusive and sustainable academic communities.

6 CONCLUSION

Both the quantitative and qualitative data collected provide insights into the factors that potentially influence postgraduate students' engagement and sense of belonging within AI-supported virtual academic communities. While several factors were identified by participants, two prominent themes were the flexibility and personalized support provided by AI-powered academic mentoring applications and the importance of meaningful interactions with academic mentors and peers. These findings are consistent with Self-Determination Theory, which emphasizes autonomy, competence, and relatedness as fundamental psychological needs that support motivation and engagement (Ryan & Deci, 2017). The significant contribution of digital mentoring quality to students' sense of belonging is also supported by this research, as reflected in its positive association with virtual academic community belonging ($\beta = 0.41$,

$p < .001$). This reinforces existing literature highlighting the importance of supportive academic relationships and social interaction in online learning environments. AI-powered mobile applications should therefore incorporate flexible academic assistance, responsive human mentoring, and opportunities for peer collaboration to strengthen students' academic connectedness, research engagement, and overall well-being within virtual academic communities.

STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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The authors declare no conflicts of interest regarding this manuscript.

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