Generative AI in Academic Research: A Descriptive Study on Awareness, Gender Usage, and Views among Pre-Service Teachers

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Abstract

This study investigated the engagement of Pre-Service Teachers (PSTs) with Generative AI (GAI) tools in their research projects, focusing on their awareness, source of awareness, usage pattern based on gender, and views of GAI tools in academic research. We adopted a descriptive survey method to collect data from one hundred and four PSTs across five institutions in Ghana using a five-point Likert-type survey instrument, which included an open-ended question. The quantitative data were analyzed using means, frequencies, percentages, standard deviations, and an independent samples t-test. The findings revealed that PSTs are familiar with GAI tools, especially ChatGPT and Google Bard. They learned about these tools through personal searches, recommendations from friends, and social media platforms. The PSTs used these tools in writing all chapters of their research projects, with the Introduction Chapter being the most common area of application, followed by the Discussion and Findings Chapter, the Literature Review Chapter, Methodology, and Summary and Conclusion. We also identified a significant gender disparity in the use of GAI tools, with male PSTs exhibiting a higher frequency of use compared to their female counterparts. Nonetheless, both genders expressed a positive attitude towards GAI tools in academic research, noting among other benefits that these tools provided them with confidence and independence in their research writing. However, they also recognized inaccuracies in the information provided by GAI tools, which led to skepticism about relying solely on these tools for their research projects. Consequently, they expressed a preference for support from their research supervisors, highlighting the importance of a balanced approach that combines the use of GAI tools with human supervision in academic research. While we recommend the integrating of GAI tools in teacher education programs, we strongly suggest that such integration should be complemented with comprehensive guidance on how these tools can be effectively used by PSTs to conduct original and advanced research.

Keywords: *Generative AI, Research, Awareness, Use, Perspectives, Pre-service Teachers (PSTs), Gender*

1. INTRODUCTION

The journey to becoming a teacher in Ghana involves a critical rite of passage for Pre-service Teachers (PSTs), the completion of a research project in their final year (Armah, 2018; Hedges, 2002). This capstone project, a culmination of the research methodologies and pedagogical practices absorbed throughout their education, often takes the form of action research. Such projects are not merely academic exercises; they are extensions of the PSTs' field experiences, designed to address real classroom challenges with innovative solutions (Iddrisu et al. 2018). However, this process is not without its difficulties. Research writing has long been a daunting task for these students, often perceived as the most challenging aspect of their academic journey (Aydin & Karaarslan, 2023; Afful et al., 2022; Azila-Gbettor et al., 2015).

In recent years, the final year research project has been marred by a troubling trend of plagiarism (Aydin, 2023; Mosha & Laizer, 2021). A practice colloquially referred to as using 'grandfather' or 'grandmother' papers, where PSTs heavily rely on the work of their predecessors, has become a crutch due to a lack of confidence in their research writing abilities (Nketsiah et al., 2023; Armah, 2017). This trend points to a broader issue of inadequate research skills among PSTs, despite the guidance provided by their assigned supervisors (Yidaan, 2021).

The emergence of Generative Artificial Intelligence (GAI) such as ChatGPT is poised to revolutionize various sectors, including education (Zhai et al., 2023). GAI, characterized by its human-like cognitive functions across diverse tasks, offers significant potential to revolutionize teaching, learning, and research methodologies (Polat, 2023; Rahman & Watanobe, 2023). Yet, the conversation around GAI on teacher education has predominantly featured the voices of teacher educators (Nyaaba, M., & Zhai.2024; Akanzire, 2023), leaving a gap in understanding its impact from the perspectives of PSTs on how they are using it in their academic activities such as their nightmare activity; research (Zhai et al., 2023).

This study, therefore, seeks to bridge this gap by exploring PSTs' engagement with GAI toolsto assess their awareness, the channels through which they have encountered these tools, and their views on GAI tools in academic research. Goswami and Dutta (2015) literature review on gender differences in technology usage reveals that gender does play a crucial role in the acceptance of new technology in certain contexts, though not universally. In this study, we also aimed to determine whether GAI tools are embraced equally by PSTs of both genders. Based on these objectives we derived the following hypotheses:

Hypothesis

Based on the objectives of the study, the following hypothesis were formulated:

H_O: *There is no statistically significant difference between male and female student teachers' use of AI tools for projects.*

H_a: *There is a statistically significant difference between male and female student teachers' use of AI tools for projects*

2. THEORETICAL UNDERPINNING

2.1 Unified Theory of Acceptance and Use of Technology

The Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003) was adopted for this study. This theory explores how technological acceptance is influenced by factors like performance expectations, effort expectations, social impact, and enabling circumstances. According to this theoretical paradigm, a user's behavioral purpose determines how they use technology. This theory is anchored on four essential constructs, including performance expectancy, effort expectancy, social influence, and facilitating conditions which directly impact the anticipated likelihood of technology adoption.

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Venkatesh et al. (2003) hypothesized that an individual's performance expectancy is a measure of how much they think that using the system will enable them to improve their performance at work. The level of ease with which the system is to be used is known as effort expectancy. An individual's perception of how strongly influential others feel they should use the new method describes the social influence. An individual's level of confidence that organizations and technical infrastructure exist to facilitate the system's use describes their level of belief in facilitating conditions. Age, gender, experience, and readiness to use act as moderators of the effects of these variables (Venkatesh et al., 2003). We therefore aimed to use these variables to examine PSTs' awareness of, use of, and opinions of GAI, such as ChatGPT, GPT-4, etc (Haman & Školník, 2023). The aspects that influence student acceptability, choice of GAI tool, and ease of use of these technologies were explored in this study.

2.2 Potential Benefits of GAI

Globally, the 21st century has experienced a rapidly changing landscape in educational practices due to advancement in technology such as artificial intelligence (Petersen, 2021). The emergence of generative artificial intelligence gives more credence to this educational transformation. World Economic Forum (2023) conceptualizes GAI as the algorithms that generate new outputs based on the data they have been trained on. World Economic Forum (2023) further posits that unlike traditional AI systems that are designed to recognize patterns and make predictions, generative AI has the potential to create new content in the form of images, text, audio, and more to aid teaching and learning outcomes.

In addition, Alshater (2022) and Terwiesch (2023) hold that the use of GAI has gained impetus in many fields of professions including education, journalism, economics, engineering, medicine and finance etc. Chen et al. (2020) noted that GAI has the potential to influence personal tutoring. For them, GAI can be used to provide personalized tutoring and feedback to students based on their individual learning needs and progress. A study by Chen et al. (2020) demonstrated that a conversational agent based on a generative model (ChatGPT) could provide personalized math tutoring to students, resulting in improved learning outcomes. Their study further emphasized that the conversational agent could provide explanations tailored to students' misconceptions and could adapt to their level of understanding.

Similarly, Johnson et al. (2016), posit that GAI could help in language translation in educational practice. That is, GAI can be used to translate educational materials into different languages, making them more accessible to a wider audience. For Johnson et al. (2016), generative model trained on a dataset of bilingual sentence pairs could accurately translate between languages, achieving state-of-the-art results on several translation benchmarks. They hold further that; generative models were able to understand the meaning of sentences in one language and to generate accurate translations in another language to aid learning outcomes. Recent study by Zhai et al (2024) on Generative AI and ChatGPT revealed that these tools can outperform human on cognitive demand task in science.

2.3 Factors that affect Students' Use of Technology

Research has established that several factors affect students' use of technology. For example, Popescu and Badea's (2020) findings indicated students spend countless hours immersed in popular technologies such as social media channels, application software and internet browsers. For Popescu and Badea (2020), technology is becoming a more prominent form of learning among students globally. However, their efficacy in using technology is limited to identifiable factors.

Blankstein (2022) pointed out that one of the factors that affect student s use of technology is access. According to Blankstein (2022), students from lower socio-economic backgrounds may have limited access to technology and the internet. This can significantly affect their ability to use technology for educational purposes. Galindo-Dominguez (2021) also identified digital literacy and competence of students as factors

that affect students' usage of technology. For Galindo-Dominguez (2021), students' digital literacy and competence with technology are fundamental factors influencing their ability to use it effectively to promote positive learning outcomes.

Galindo-Dominguez (2021) further posited that the pedagogical approaches adopted by schools play a critical role in students' usage of technology. They emphasize that the integration of technology into the curriculum is an important benchmark to influence students' ability to use technology. They concluded that in a meaningful pedagogically sound approach, students are more likely to engage with it. Montiel et al., (2020) linked students' effectiveness in the use of technology to cultural and societal factors. Montiel et al. (2020) further opined that cultural norms and values can influence students' perception of technology in education. For them, some cultures are more receptive to technology than others.

2.4 Gender and Digital Tools

The discourse on the digital gender divide presents a complex interplay of women's access to and use of digital tools, mostly in developing countries. Martin (2011) empirically challenges the notion of females being technophobic by demonstrating that, when controlling for employment, education, and income, women are more engaged users of digital tools than men. This suggests that the digital gender divide is less about an inherent reluctance among women to embrace technology and more about the structural barriers that limit their access and usage (Martin, 2011). Supporting this perspective, Goswami and Dutta (2015) highlight that gender plays a significant role in the intention to use technology in certain contexts, pointing towards a nuanced understanding of technology adoption that transcends simplistic binary distinctions (Goswami & Dutta, 2015). In addition, Liu's (2019) study finds no statistically significant gender difference in the knowledge of social media concepts among students in higher education yet notes gender-specific preferences in the use of social media tools, with males favoring resource-based platforms and females preferring relationship-building platforms (Liu, 2019). In the context of eHealth applications, Prinzellner and Simon (2022) emphasize the importance of gender-sensitive language and the display of medical information to ensure inclusivity for users with low eHealth literacy, underscoring the need for a gender-balanced approach in technology design and implementation (Prinzellner & Simon, 2022).

Khalid and Khan's (2022) findings recognize the broader digital divide exacerbated by the COVID-19 pandemic, indicating the urgency of addressing these gender disparities to achieve universal digital access and mitigate the adverse impacts on economic growth and social inclusion. These studies recognize gender differences in digital technology usage, and understanding these differences requires further investigation. GAI, as an emerging technology, could bridge the digital divide and promote gender equality in technology use in developing countries or elsewhere.

3. METHOD

We adopted a descriptive study using closed and open-ended survey. This approach helped us to systematically gather data from our target population, pre-service teachers (PSTs) in relation to our research objectives (Mishra & Alok, 2022; Pandey and Pandey., 2021). Specifically, this method aided us in obtaining the awareness, use, and views of PSTs about GAI (Borenstein & Howard, 2021; Creswell & Plano Clark, 2011).

4. PARTICIPANTS

The study involved one hundred and four (104) PSTs from five teacher education institutions in Ghana. The institutions included two research universities and three colleges of education. The PSTs were in the final years of their program and had either completed their research or were in the process of conducting their final research projects. PSTs in the colleges of education typically engage in research projects mostly in their final year of the program during or after their field teaching practice. The final research projects at teacher

education institutions in Ghana involve students conducting an action research project after their teaching internship.

For convenience, the participants of this study were supervisees under the supervision of some of the authors in the various institutions during the research study. With this sampling technique, the participants were well-informed about the study and the survey before responding to them. However, we acknowledge the disadvantage of using convenience sampling as it is prone to biases (e.g., Donaldson et al., 2019; Ucar & Canpolat, 2019) and so the survey was opened to other interested members in the various institutions that met our criteria. The study involved 20 females representing 19.2% and 84 males representing 80.8%. Most participants fell within the age bracket of 21-25 years, representing 44.1%, followed by 26-30 years representing 29.9% and above 30 representing 25%, while the remaining fell within the age bracket of 16-20 years, with the least percentage of 1.0%. All of them were final-year students who had completed their research projects or were conducting their final research projects.

5. DATA COLLECTION

The main instrument for this study was a five-point Likert-type questionnaire with an open-ended item. We adapted An et al.'s (2023) Scale on "Modeling English teachers' behavioral intention to use artificial intelligence in middle schools" and Rowland's (2023) model on "stages of writing + possible model to guide thinking about the human-AI collaboration-collusion writing continuum" to construct the questionnaire items. Van Katwijk et al.'s (2023) findings on "Most Important Learning Outcomes of Pre-Service Teacher Research" also supported us in modifying the survey questions. Since some of the items were substantially changed from the adapted scales, we employed the help of two educational professors to check the content validity of the scale and advise us on any necessary revisions. The revised scale consisting of 15 items was used for this study. It solicited the demographic information of the participants, their familiarity with GAI tools, the areas of their research where they employ GAI assistance, and their general views of GAI in their research. These questions included closed-ended questions along with an optional open-ended question to gather the views of PSTs about GAI use in research at colleges of education.

We used Google Forms for data collection. Due to the physical distance between participating institutions and our participants, Google Forms provided the most convenient approach for us. Participants were asked for consent first and were given the option to participate or not. They were assured of anonymity, confidentiality, and the voluntary nature of their participation. The Google Forms survey link was shared with participants via their WhatsApp platforms, allowing them to respond at their convenience within two weeks.

6. DATA ANALYSIS

The data collected from closed-ended questions was analyzed using descriptive statistics. This involved calculating means, frequencies, standard deviations, and percentages to determine the distribution. The survey utilized a five-point Likert-type scale for PSTs' views on GAI, with weightings indicating Strongly Agree (5), Agree (4), Neutral (3), Disagree (2), and Strongly Disagree (1). Negative items were rephrased; a mean score (M) above 3.0 indicates a positive view towards GAI, while a mean score below 3.0 indicates a negative view. Another five-point Likert-type scale was used to gauge PSTs' use of GAI with response options ranging from Never (1) to Very Often (5). The descriptive statistics of how frequently student teachers utilize GAI tools for projects were analyzed, and an independent samples t-test was conducted to examine potential differences between male and female PSTs in their use pattern. Open-ended questions were thematically analyzed to support the findings, initially coded into emerging themes. Quotations in the study were anonymized using pseudonyms for the participants' privacy.

7. FINDINGS

Addressing the first research question concerning pre-service teachers' (PSTs) familiarity with GAI tools, we explored their awareness and familiarity with these tools. Figure 1 illustrates the GAI tools that PSTs are aware of or familiar with. It shows that they are aware of numerous GAI tools but are particularly familiar with ChatGPT, followed by Google Bard. Figure 2 demonstrates how PSTs became acquainted with these tools, with a significant portion (39.2%) indicating they discovered the tools through personal research or readings. About 27.5% reported discovering the tools through their friends' recommendations, while 17.6% mentioned learning about them in their formal academic settings. A smaller percentage (12.7%) indicated they found out about GAI tools through social media platforms like WhatsApp, with the remaining learning about them through online courses or tutorials.

Figure 3 provides insight into how often PSTs employ GAI tools in their research projects. It was observed that 48.1% of PSTs sometimes use GAI tools in their research, while 13.9% use them often or very often. Notably, only a minority (14.8%) has never utilized GAI tools in their research projects. For those who have used these tools, they found them beneficial across all chapters or sections of their research projects. The chapters or sections where these tools were most helpful to them included introductory chapters, literature review chapters, findings and discussions, and data analysis and methodology chapters (as illustrated in Figure 4). This indicates that GAI tools are being employed by PSTs in all aspects of their research projects.
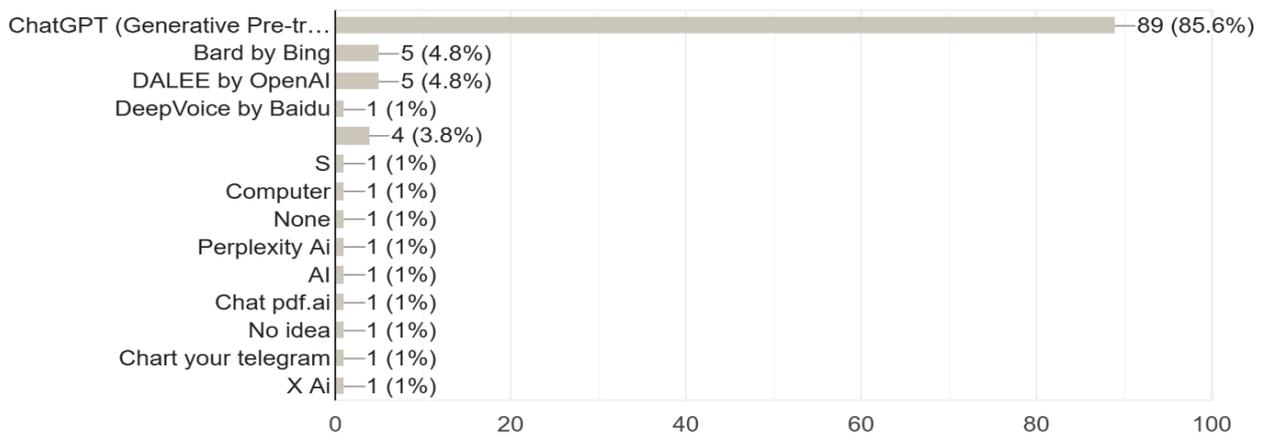
Figure. 1. PST Awareness of GAI tools
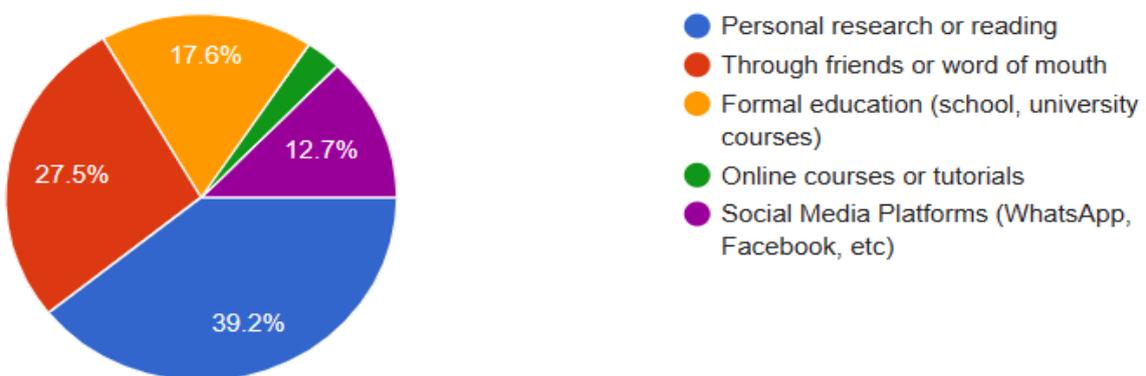
**Figure. 2**. How PSTs Got to Know about GAI tools
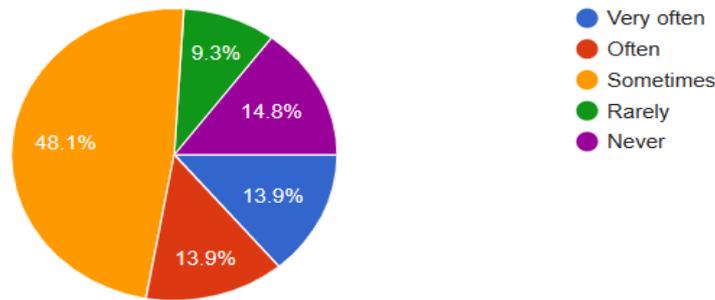
Figure. 3: Frequency of GAI Usage in Research Project by PST

Which Chapter was GAI most useful in your research studies?

104 responses
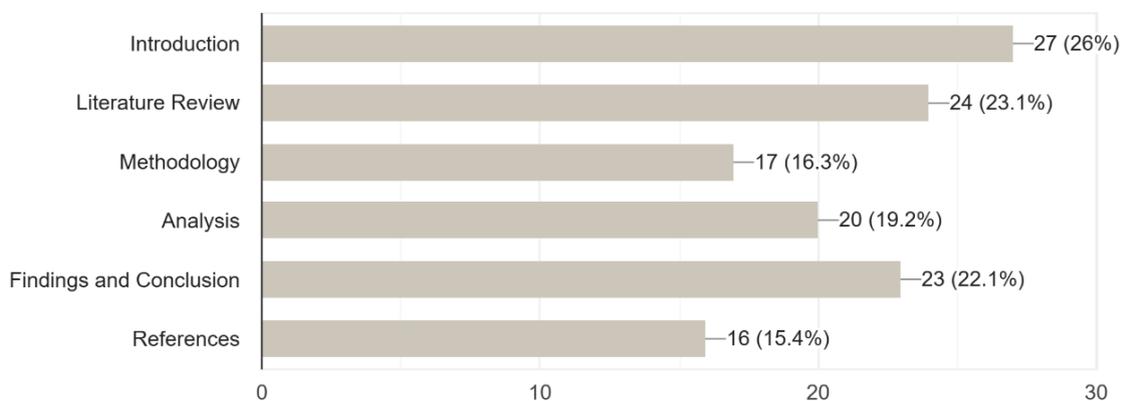
Figure. 4. *The Chapters of Research that PSTs Use GAI in Writing* igure 4). This indicates that GAI tools are being employed by PSTs in all aspects of their research projects.

7.1 Hypothesis

This hypothesis looked for a difference between two groups: male and female PSTs use of AI tools. Table 1 and Table 2 illustrate variability between the male and female PSTs use of AI tools for their research projects.

Table 1. Group Statistics of How Often PSTs Use GAI tools for projects

	Gender	N	Mean	Std. Deviation	Std. Error Mean
Use	Female	20	2.85	1.04	0.23
	Male	84	3.07	1.21	0.13

From the observation of the group means in Table 1, it could be indicated that male student teachers (M = 3.07, SD = 1.21) often use AI tools than their female counterparts (M = 2.85, SD = 1.04).

Table 2. Independent Samples T-Test of how often PSTs use GAI tools for research projects

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error Diff.	95% Confidence Interval of the Difference		
									Lower	Upper	
Use	Equal variances assumed	0.46	0.50	-0.75	102	0.45	-0.22	0.29	-0.80	0.36	

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An independent samples t-test was conducted to examine whether there was a significant difference between male and female student teachers on how often they use GAI tools for projects. The t-test results in Table 2, revealed a statistically significant difference between male and female PSTs' use of AI tools for their research projects (t = -0.75, df = 102, p < 0.05). Hence, we reject the null hypothesis and conclude that there was a statistically significant difference between male and female PSTs' use of AI tools for their research projects.

7.2 PSTs Views and Experiences of GAI

Table 3. Student teachers' views and experiences with the use of AI tools for research projects

Items	Group	N	Mean	Std. Dev.	t	Sig. value
GAI has the potential to positively impact students' assessments like research project	Female	20	3.45	1.23	-0.32	0.75
	Male	84	3.54	1.04		
GAI has the potential to negatively impact students' assessments like research project	Female	20	2.45	1.0	-1.88	0.06
	Male	84	2.96	1.12		
GAI helped me understand various complex parts of my research study better than I knew before	Female	20	3.65	0.88	0.26	0.79
	Male	84	3.58	1.04		
With the help of GAI, the literature review section was an easy task for me	Female	20	3.55	0.76	0.65	0.51
	Male	84	3.39	1.01		
I didn't require much assistance from anyone for my research once I started using GAI	Female	20	3.25	1.07	0.77	0.45
	Male	84	3.02	1.21		
I felt more confident conducting my research with GAI's assistance	Female	20	3.45	0.83	-0.22	0.83
	Male	84	3.50	0.94		
GAI tools explained things better than my supervisor had the time to do for me	Female	20	2.65	1.04	-0.81	0.42
	Male	84	2.87	1.10		
It is expensive using GAI tools for research	Female	20	2.90	1.02	0.16	0.87
	Male	84	2.86	1.08		
The information provided by GAI tools was not accurate enough, so I never trusted them	Female	20	2.40	0.88	-1.75	0.08
	Male	84	2.82	0.98		
I suggest GAI tools be incorporated into our research courses, and students be taught how to use them in their research studies	Female	20	3.35	1.18	-1.15	0.25
	Male	84	3.67	1.09		
Most students might not conduct original research due to GAI	Female	20	3.05	1.23	-1.44	0.15
	Male	84	3.48	1.18		

Source: Field Data (2023)

From Table 3, it could be observed that both female and male PSTs had positive/ favourable views and experiences with the use of GAI tools for research projects. For example, female PST agreed to the statement 'GAI helped me understand various complex parts of my research study better than I knew before' with a mean and standard deviation of 3.65 and 0.88 respectively. On the other hand, male student teachers agreed to the same statement with a mean of 3.58 and a standard deviation of 1.04. The difference between the groups was found not to be statistically significant (t = 0.26, p > 0.05). The finding indicated that both female and male students have confidence in conducting their research with the assistance of GAI tools (female: M=3.45, SD=0.83), (male: M=3.50, SD=0.94). The t-value and significance level for this item indicate that the difference between genders is not statistically significant (t = -0.22, p > 0.05). Female PSTs reported a moderate level of independence in conducting their research with the help of GAI tools (female: M=3.25, SD=1.07), while male students reported a slightly lower level of independence (male: M=3.02, SD=1.21). The

t-value and significance level for this item suggest that the difference between the genders is not statistically significant (t = 0.77, p > 0.05). A consensus emerged from the thematic analysis that GAI has the potential to enhance academic research and assist PSTs in completing their assignments, as indicated by one male participant (M1). This view was further echoed by a female participant (F1), who highlighted the efficiency and speed with which learning can be achieved using GAI. Participant M2 advocated for the utility of GAI in personal studies as a means of accessing supplementary information.

M1: AI is helping most of us not only with research work but assignments.

F1: GAI makes learning much easier and faster.

M2: It is good when doing your personal studies, it provides additional information for you.

However, the PSTs were somewhat neutral with a tendency towards disagreement on the effectiveness of GAI tools in explanation compared to their supervisors. Female students felt that GAI tools explained things somewhat better than their supervisors had time to do, with a slight disagreement on average (female: M=2.65, SD=1.04). Male PSTs were slightly more neutral with reservations about the ability of GAI tools to explain things (male: M=2.87, SD=1.10). The t-value and significance level indicate that the observed difference in opinions between genders is not statistically significant (t = -0.81, p > 0.05). Female PSTs expressed concerns about the accuracy of GAI tools, indicating a general mistrust (female: M=2.40, SD=0.88), and male students also showed some level of mistrust but to a lesser extent (male: M=2.82, SD=0.98). The t-value and significance level suggest that the difference in trust might be approaching significance, warranting further investigation (t = -1.75, p < 0.10). Furthermore, there was concern among female students that the use of GAI might lead to a lack of originality in research (female: M=3.05, SD=1.23), and male PSTs also shared this concern, though they were slightly more optimistic (male: M=3.48, SD=1.18). The t-value and significance level indicate that the difference between genders is not statistically significant, but it is approaching significance (t = -1.44, p < 0.15). The PSTs further expressed the view that GAI responses are not always accurate. They expressed concern that reliance on GAI could diminish students' critical thinking and logical reasoning skills. They warned that GAI could potentially ruin them if not used carefully, as they tend to prefer easier solutions and are reluctant to exert effort.

F2: It's good application software for students but its solutions are not accurate sometimes.

M3: We are becoming susceptible and vulnerable to GAI thereby alleviating our critical thinking and logical reasoning as students.

M4: In fact, GAI will spoil the youth, if care is not taken because they always want cheaper things. They don't want to stress themselves.

F3: AI can give students too much unverified information, which sometimes is wrong. Believing everything AI says can confuse them instead of helping them learn. So, AI might be doing more harm than good in schools.

M5: So sometimes is not everything you understand.

Nonetheless, the perception of the expense associated with using GAI tools for research was slightly disagreeable among female students (female: M=2.90, SD=1.02), and the same among male students (male: M=2.86, SD=1.08). The statistical test suggests no significant difference between the groups (t = 0.16, p > 0.05). Female students were positive about the suggestion to incorporate GAI tools into research courses (female: M=3.35, SD=1.18), and male students were even more favorable towards this suggestion (male: M=3.67, SD=1.09). The difference between genders was not statistically significant (t = -1.15, p > 0.05). The PSTs expressed uncertainty about any undiscovered methods of using GAI more effectively for their studies but expressed openness to welcoming such methods if they exist.

F5: If there's any other way of using GAI effectively, I don't know and have not yet discovered but if there's any other way to use GAI more effectively to help our studies, we welcome it.

8. DISCUSSION

The study showed that GAI tools have seen a significant uptick in awareness and usage among PSTs in Ghana, with most of them indicating awareness of OpenAI's ChatGPT, Google Bard, and DALLE (Strzelecki, 2023). This recognition of GAI tools among the PSTs reflects and confirms GAI tools' broader visibility and their applicability in educational settings (Strzelecki, 2023; Mansor et al., 2022). The prominence of ChatGPT in our findings is not surprising as it can be described as emerging GAI tools that bring much attention to AI in 2022. ChatGPT has capabilities in natural language processing and generation beneficial for research purposes (Seshadri & Swamy, 2023). The findings align with Venkatesh et al. (2003) UTAUT, which posits that awareness and adoption of new technologies follow a pattern influenced by social systems and communication channels (Kaminski, 2011). However, the few PSTs (14.8%) who have never used GAI tools in their research projects may reflect a gap in access or skills necessary to leverage these technologies effectively (Alam, 2021; Leese, 2010).

The pathways through which PSTs have come to learn about GAI tools are equally fascinating, with personal research or readings being the most common method, suggesting proactive engagement with technological advancements among the PSTs (Tapalova & Zhiyenbayeva, 2022). This also supports Venkatesh et al. (2003) UTAUT element on ease of use. This is an indication that GAI tools might not necessarily require any sophisticated skills in using them. The finding indicating that teacher education institutions play a lesser role in PSTs' awareness may point to a lag in the integration of emerging technologies in teacher education curricula or that the institutions are still in doubt about how to incorporate these tools in their curricula (Hwang & Shin, 2019; Nyaaba & Zhai, 2024; Kouame, 2012). The findings further highlight the role of digital media in PSTs' learning, emphasizing its growing influence as a medium for professional development and knowledge acquisition (Devi et al., 2022; Limna et al., 2022).

The disparity in the frequency of GAI tool usage between male PSTs and female counterparts confirms the wider discourse on gender differences in technology adoption and usage, suggesting that males are more inclined towards technology (Lee et al., 2022; Acilar & Sæbø, 2023). However, this finding appeared different from Martin's (2011) finding that females are more engaged users of digital tools than males (Ahn et al., 2022; Antonio & Tuffley, 2014). It tends to support Khalid and Khan's (2022) findings which recognized the broader digital divide between females indicating the urgency of addressing these gender disparities to achieve universal digital access and mitigate the adverse impacts on economic growth and social inclusion (Prinzellner & Simon, 2022). Addressing these disparities is crucial for ensuring equitable access to AI educational resources and for preparing all PSTs to effectively use AI in their future teaching practices, thereby fostering an inclusive digital literacy that is imperative for the 21st-century educator (Lee et al., 2022; Ahn et al., 2022).

The recognition and relevance of human supervisors expressed by the PSTs show a critical aspect of educational technology integration in teacher education programs (Molenaar, 2022). While GAI has been lauded for its potential to personalize learning and research by the PSTs (Seshadri & Swamy, 2023), the mentorship offered by human supervisors appears to remain indispensable (Kim et al., 2022; Zhai, 2023). This finding is consistent with Ausat et al.'s (2023) finding that emphasizes the irreplaceable value of human interaction in the development of critical thinking and research skills.

The PSTs' skepticism in the accuracy of information provided by GAI tools could be reflective of general hesitation to accept AI outputs as echoed in recent studies (Rahman & Watanobe, 2023; Nazaretsky et al., 2022). This aligns with the concerns raised about the impact of GAI on the originality of research as well

(Choung et al., 2023; Mosha & Laizer, 2021). This suggests a need for educational strategies that emphasize original thought and critical engagement with GAI-generated content, ensuring that the use of such tools enhances rather than diminishes the quality and originality of student research (Haider & Sundin, 2022).

The integration of GAI tools in research projects within teacher education programs is widely accepted among pre-service teachers (PSTs). This reflects the growing trend towards recognizing the benefits and acceptance of GAI in education, as highlighted by Çalışkan et al. (2022) and Escotet (2023). Moreover, the positive impact of GAI is further underscored by reports from both female and male student teachers, who have experienced increased confidence in conducting research with the support of these tools (Rahman & Watanobe, 2023; Tapalova & Zhiyenbayeva, 2022). PSTs also believe that GAI has the potential to significantly enhance assessments and advocate for its incorporation into their research courses. This consensus on the potential of GAI encourages educators to prepare students for technologically advanced research and practice (Sok & Heng, 2023; Zhai et al., 2023).

9. CONCLUSION

In this study, we explored PSTs engagement with GAI tools in their research projects: their awareness, how they learned about these tools, their usage based on gender and their overall views on GAI tools in academic research. The findings revealed that PSTs have a high level of familiarity with GAI tools, especially OpenAI's ChatGPT and Google Bard. The PSTs mostly learned about these tools through personal searches, from friends and social media platforms. These tools were primarily used in all chapters of their research projects, with the Introduction Chapter being the most common area of application, followed by the Discussion and Findings Chapter, the Literature Review Chapter, Methodology, etc.

There was also a significant difference in the use of GAI tools between male and female PSTs, with male PSTs exhibiting a higher frequency of use compared to their female counterparts. Despite this usage disparity, both genders agreed on the benefits of GAI, recognizing the confidence and independence it provided them in their research writing. However, they also acknowledged the potential inaccuracies in information that GAI tools could offer, leading to skepticism regarding relying entirely on them for support in their research projects. Consequently, they expressed a preference for support from their research supervisors, emphasizing the need for a balanced approach that combines GAI tools with human supervision in their research projects. Based on these findings, we recommend the integration of GAI tools into teacher education programs, accompanied by guidance on how they can be used effectively by PSTs to conduct original and advanced research.

10. LIMITATIONS OF THE STUDY AND IMPLICATIONS FOR FUTURE STUDIES

It is worth acknowledging the study's limitations as we interpret the findings. Though we appreciate the fact that convenience sampling, a non-probabilistic sampling can be used in quantitative research, it is prone to the challenges of representativeness thereby reducing the statistical power of the convenience sample. Also, this study was an online descriptive survey with a low response rate despite the efforts to get more PSTs involved in the survey. These suggest that the outcomes of the study cannot be generalized to the study's population. Considering this, future studies that employ probabilistic sampling techniques to give a fair representation of the study's population would be much needed.

AUTHORS` CONTRIBUTIONS

All authors contributed equally to the manuscript and read and approved the final version of this paper.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY

All relevant data are within the paper and its Supporting Information.

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