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GENDER DIFFERENCES IN COMPUTER SCIENCE EDUCATION PRE-SERVICE TEACHERS' PERFORMANCE IN GENERATIVE ARTIFICIAL INTELLIGENCE-ASSISTED LESSON PLANNING IN UNIVERSITIES IN NORTH-EAST NIGERIA

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Abstract

The study examined gender differences in Computer Science Education pre-service teachers' performance in Generative Artificial Intelligence (GAI)-assisted lesson planning in universities in North-East Nigeria. One research objective, one research question and one null hypothesis guided the study. Quasi-experimental research design, specifically the pretest-posttest non-equivalent control group design, was adopted for the study. The population of the study comprised 65 Year Three Computer Science Education pre-service teachers in the selected universities in the North-East. A sample of 63 participants was used for the study, comprising 41 pre-service teachers in the experimental group and 22 in the control group. The experimental group comprised 25 male and 16 female pre-service teachers, while the control group comprised 16 male and 6 female pre-service teachers. The Lesson Planning Performance Test (LPPT) was used for data collection. Experts in relevant fields validated the instrument. Its reliability was established through pilot testing involving Computer Science Education pre-service teachers from two non-participating universities. The reliability coefficient of LPPT was found to be 0.82. The experimental group was exposed to GAI-supported lesson planning, while the control group was taught using the conventional lesson-planning approach. Data collected were analysed using mean and standard deviation for answering the research question, while Analysis of Covariance (ANCOVA) was used to test the null hypothesis at 0.05 level of significance. The findings revealed that female pre-service teachers in the GAI experimental group recorded a slightly higher posttest performance mean score of 80.27 than their male counterparts, who recorded a mean score of 79.21, resulting in a mean difference of 1.06 in favour of the female pre-service teachers. However, the ANCOVA result showed that there was no statistically significant difference between the posttest performance mean scores of male and female pre-service teachers exposed to GAI-assisted lesson planning, in which $F(1, 27) = 0.325$, $p > .05$. The study concluded that gender did not significantly influence the performance of Computer Science Education pre-service teachers in GAI -assisted lesson planning. It was recommended among others, that teacher educators should provide equitable opportunities for male and female pre-service teachers to participate in GAI-assisted lesson-planning activities and ensure equal access to digital devices, reliable internet connectivity, training, and technical support.

Keywords: Generative Artificial Intelligence, Gender, Performance, Pre-Service Teachers

INTRODUCTION

Generative Artificial Intelligence (GAI) refers to artificial intelligence technologies capable of generating new content, including text, explanations, instructional materials, lesson-plan components, learning activities, and assessment tasks, by way of responding to user prompts. In teacher education, GAI tools can support pre-service teachers in developing instructional objectives, organising lesson content, selecting teaching strategies, designing learning activities, and preparing assessment procedures (Ayanwale & Olatunji, 2023; Ogunyemi & Adebayo, 2024).. These capabilities have important implications for Computer Science Education, where lesson planning requires the systematic organisation of abstract and interconnected concepts, practical activities, problem-solving experiences, and technology-enhanced learning resources.

Computer Science Education pre-service teachers are those teachers who are being prepared to acquire fundamental subject-matter and pedagogical knowledge, technological

competence, and professional skills required for effective Computer Science instruction. A central component of their professional preparation is the ability to develop effective lesson plans that translate curriculum objectives and subject content into meaningful classroom learning experiences. This is particularly important in Computer Science because many concepts are abstract, logical, hierarchical, and skill-oriented. Topics such as programming, algorithms, data structures, databases, and computational thinking often require careful sequencing, scaffolding, practical demonstrations, coding activities, problem-solving tasks, and appropriate assessment strategies. Consequently, effective lesson planning requires pre-service teachers to integrate content knowledge with pedagogical decisions and technological resources.

Lesson planning performance refers to the extent to which a pre-service teacher is able to produce a coherent, purposeful, and pedagogically appropriate lesson plan that demonstrates the effective organisation of instructional objectives, content, teaching methods, learning activities, instructional resources, and assessment procedures (Celik et al., 2025). A high level of lesson-planning performance is demonstrated when the components of a lesson plan are appropriately aligned and when the proposed activities are relevant to the intended learning outcomes and the characteristics of the learners. For Computer Science Education pre-service teachers, effective performance in lesson planning also involves the ability to incorporate practical and technology-supported learning experiences that facilitate computational thinking, problem solving, creativity, and active learner participation.

Despite the importance of lesson planning in teacher preparation, pre-service teachers may experience difficulties in developing high-quality lesson plans. Such difficulties may include formulating measurable instructional objectives, selecting appropriate teaching strategies, sequencing content, integrating instructional resources, designing learner-centred activities, and aligning assessment tasks with learning outcomes (Shogbesan, Iwintolu, Akindahunsi, Zakariya, Apata & Abdulganiyu, 2026). These challenges may be particularly pronounced in Computer Science Education because of the technical and abstract nature of the subject. The need to improve pre-service teachers' lesson-planning performance has therefore, encouraged researchers and teacher educators to explore innovative technologies that can provide instructional support and facilitate the development of pedagogical competence.

The emergence of GAI provides a potentially valuable technological resource for supporting lesson-planning performance. GAI tools can assist pre-service teachers in generating lesson objectives, organising instructional content, suggesting teaching strategies, developing classroom activities, and creating assessment questions. When used appropriately, these tools may reduce some of the cognitive demands associated with lesson planning and enable pre-service teachers to devote greater attention to evaluating and refining instructional ideas. Kasneci et al. (2023) noted that large language models such as ChatGPT have considerable potential to support educational processes, although their use requires critical evaluation and responsible human oversight. Similarly, Tlili and others (2023) emphasized that generative AI applications present opportunities for education while also requiring educators and learners to develop the competence necessary to evaluate and appropriately use AI-generated content.

The effectiveness of GAI-assisted lesson planning however, may depend on several individual and contextual factors. One factor that has attracted attention in educational technology research is gender. Gender differences in technology use have historically been associated with variations in technological confidence, digital competence, access to digital resources, and attitudes towards emerging technologies (Kymäläinen, Elo, & Södervik, 2024). However, the increasing accessibility and usability of AI-based tools may be contributing to a reduction in some traditional gender disparities. Recent research suggests that both male and female students can engage positively with generative AI when they perceive the technology as useful, accessible, and relevant to their academic and professional activities (Chan & Hu, 2023). Therefore, when male and female pre-service teachers receive comparable training, equal access to GAI tools, and similar opportunities for practice, gender differences in performance may be reduced.

The performance of pre-service teachers in GAI-assisted lesson planning is particularly important because the use of AI-generated content does not automatically guarantee the

development of effective lesson plans. GAI may produce content that is inaccurate, generic, pedagogically inappropriate, or insufficiently aligned with curriculum objectives. Therefore, pre-service teachers must possess the ability to critically evaluate AI-generated suggestions, adapt them to learners' needs, and integrate them with their pedagogical and content knowledge. The quality of a lesson plan produced with GAI assistance may therefore, depend not only on the availability of the technology but also on the user's ability to exercise professional judgement and pedagogical reasoning. In Computer Science Education, this issue is particularly significant because lesson plans often need to accommodate practical activities, coding exercises, problem-solving tasks, demonstrations, and technology-based learning resources. A pre-service teacher must be able to determine whether AI-generated recommendations are suitable for the learners, the subject content, the available technological resources, and the intended learning outcomes. The use of GAI should therefore be viewed as a support mechanism rather than a replacement for the professional judgement of the teacher.

The question of whether gender influences the performance of pre-service teachers in GAI-assisted lesson planning is therefore, worthy of investigation. Although emerging research (for instance, Chan & Hu, 2023) has examined gender differences in attitudes, acceptance, and readiness towards AI, there is comparatively limited empirical evidence concerning gender differences in actual performance on a practical professional task such as lesson planning. This gap is particularly relevant in the context of Computer Science Education pre-service teachers in North-East Nigeria, where access to digital technologies, digital competence, and opportunities for AI-related training may vary among students. The study similarly identifies gender as a variable that may influence how pre-service teachers use GAI for lesson planning and emphasises the need to examine whether GAI benefits male and female pre-service teachers equally. Therefore, the study seeks to answer the following fundamental question: What are the gender differences in Computer Science Education pre-service teachers' performance in generative artificial intelligence-assisted lesson planning in universities in North-East Nigeria?

OBJECTIVE OF THE STUDY

To determine the performance of Computer Science Education pre-service teachers in lesson planning in the experimental group based on gender

RESEARCH QUESTION

What are the posttest performance mean scores of Computer Science Education pre-service teachers in lesson planning in the experimental group based on gender?

HYPOTHESIS

The following null hypothesis is stated and shall be tested at 0.05 level of significance:
There is no significant difference in the posttest performance mean scores of Computer Science Education pre-service teachers in lesson planning in the experimental group based on gender.

LITERATURE REVIEW

Lesson planning is a fundamental professional activity through which teachers organize instructional objectives, lesson content, teaching strategies, learning activities, instructional resources, and assessment procedures. For Computer Science Education pre-service teachers, lesson planning involves additional demands because of the practical and technological nature of the subject. Effective lesson plans must often combine theoretical explanations with practical coding activities, demonstrations, simulations, problem-solving exercises, and opportunities for learners to apply computational concepts.

GAI has introduced new possibilities for supporting lesson planning by enabling users to generate and refine instructional content through natural-language prompts. GAI tools can assist in developing lesson objectives, suggesting teaching approaches, generating learning activities, organising instructional content, and developing assessment tasks. Kasneci et al. (2023) argued that large language models have significant potential to support education but should be used

with appropriate human oversight. This is particularly relevant to lesson planning because AI-generated outputs may require teachers to verify accuracy, relevance, appropriateness, and alignment with curriculum expectations.

Recent developments in teacher education further suggest that GAI may support pre-service teachers in developing instructional materials and lesson plans. Moorhouse et al. (2023) highlighted the importance of preparing future teachers for AI-assisted instructional practices and emphasised the need for teacher education programmes to develop appropriate competencies for responsible AI use. Similarly, Celik et al. (2025) demonstrated the growing relevance of generative AI in lesson planning and teacher competence, particularly where pre-service teachers are required to interact with AI tools and develop the capacity to critically evaluate and refine AI-generated instructional suggestions.

The potential benefits of GAI-assisted lesson planning are particularly relevant to Computer Science Education. Because Computer Science concepts are often abstract and require practical application, GAI can provide pre-service teachers with alternative ideas for explaining difficult concepts, developing coding-related activities, creating examples, and designing assessment tasks. However, effective use requires the pre-service teacher to determine whether the generated content is pedagogically appropriate and technically accurate. Consequently, performance in GAI-assisted lesson planning should be understood as a combination of technological use and professional pedagogical judgement.

Gender is an important variable in studies of educational technology because male and female learners may have different experiences with technology, including differences in access, confidence, digital competence, and previous exposure. For instance, Kymäläinen et al. (2024) examined gender differences in AI readiness and highlighted the relevance of gender when considering preparedness for AI-related learning. Although differences in readiness may exist, the presence of a gender difference in readiness does not necessarily imply a corresponding difference in actual performance after learners receive equivalent training and access to technology.

Chan and Hu (2023) reported that students generally recognise several benefits of generative AI for academic activities, although they also expressed concerns about accuracy, ethics, and dependence on AI. Their findings suggest that users' perceptions of usefulness and challenges associated with generative AI may shape how they engage with the technology. In the context of teacher education, such factors could potentially influence how effectively male and female pre-service teachers apply GAI to practical tasks.

The relationship between gender and performance in AI-assisted educational tasks is therefore, complex. On one hand, previous technological experience and confidence may provide an advantage to some learners. On the other hand, structured instruction, equal access, and guided practice may minimise such differences. Tlili et al. (2023) noted that the educational value of ChatGPT and similar AI tools depends substantially on how they are integrated into learning environments. Users must possess the capacity to critically evaluate AI-generated outputs rather than simply accept them without verification.

The quality of lesson-planning performance may therefore, depend more strongly on the pedagogical and technological competencies of pre-service teachers than on gender alone. When male and female pre-service teachers receive the same GAI-assisted lesson-planning intervention and have comparable access to digital tools, any observed differences in performance may be reduced. Conversely, if differences remain, they may suggest the need for additional support or differentiated interventions.

Literature also suggests that GAI should not be treated as an automatic substitute for teacher expertise. UNESCO (2023) emphasised the importance of equitable access and responsible use of technology in education. More recent discussions of generative AI in education similarly stress the need for human agency, critical evaluation, ethical awareness, and appropriate pedagogical integration. Therefore, the effectiveness of GAI-assisted lesson planning should be evaluated by examining the actual quality of lesson plans produced by pre-service teachers rather than merely their frequency of AI use.

METHODOLOGY

Quasi-experimental research design was adopted for the study, specifically the pretest-posttest non-equivalent control group design. The population comprised 65 Year Three Computer Science Education pre-service teachers in the two sampled universities in North-East Nigeria. The sample size for the study comprised 63 participants, with 41 in the experimental group and 22 in the control group. For the experimental group, 25 participants were male while 16 were female participants, and for the control group, 16 were male while 6 were female participants. The instrument for data collection was the Lesson Planning Performance Test (LPPT). The instrument was validated by experts in relevant fields to establish its suitability for assessing pre-service teachers' performance in lesson planning. The instrument was pilot tested with Computer Science Education pre-service teachers not part of the sample. The reliability of the instrument, using Cronbach's Alpha was found to be Data collected were analysed using mean and standard deviation for answering the research question Analysis of Covariance (ANCOVA) was used to test the null hypothesis at 0.05 level of significance.

RESULTS

Research Question: What are the posttest performance mean scores of Computer Science Education pre-service teachers in lesson planning in the experimental group based on gender?

The data for answering this research question are presented in Table 1.

Table 1: Mean and Standard Deviation of Computer Science Education Pre-service Teachers' Posttest Performance Mean Scores in Lesson Planning in the Experimental Group Based on Gender.

Gender	N	$\bar{x}$	SD	$\bar{x}$ Diff.
Male	25	79.21	10.63	
				1.06
Female	16	80.27	11.42	

Table 1 presents the posttest of Computer Science Education male and female pre-service teachers' performance mean scores in lesson planning in the experimental group. The table reveals that male pre-service teachers yielded a posttest mean score, $\bar{x}$ =79.21, SD=10.63, while the female pre-service teachers' had $\bar{x}$ =80.27, SD=11.42. The posttest mean difference was 1.06 in favour of female pre-service teachers. This indicates that the use of generative artificial intelligence enhanced the female pre-service teachers' performance in lesson planning.

Hypothesis: There is no significant difference in the posttest performance mean scores of Computer Science Education pre-service teachers in lesson planning in the experimental group based on gender

The data for testing this hypothesis are presented in Table 2.

Table 2: Summary of ANCOVA Result of the Difference in the Posttest Performance Mean Scores of Male and Female Computer Science Education Pre-service Teachers in the Experimental Group

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	92.118[a]	2	46.058	.382	.686
Intercept	9876.588	1	9876.588	81.873	.000
Pretest interest (Male and Female)	84.258	1	84.258	.698	.411

Group	39.155	1	39.155	.325	.574
Error	3257.084	27	120.633		
Total	193434.000	30			
Corrected Total	3349.200	29			

a R Squared = 0.28 (Adjusted R Squared = -.045)

Table 2 presents the result of Analysis of Covariance (ANCOVA), which was conducted to determine if a significant difference existed in the lesson planning performance mean scores of male and female Computer Education pre-service teachers in the experimental group. The table reveals that F(1, 27) = .33, P > 0.05. Since the p-value of .574 is greater than 0.05 level of significance, the null hypothesis was retained, indicating that there was no statistically significant effect of gender on the pre-service teachers' performance in lesson planning using generative artificial intelligence.

The result further reveals an adjusted R Squared value of -.045, which means that the variables included in the model (gender and pretest performance scores) do not meaningfully explain the variation in the dependent variable, which is pre-service teachers' performance in lesson planning. The negative adjusted R Squared value indicates that the model performs worse than a model that uses only the overall mean to predict posttest performance scores, suggesting that other factors not included in the study could account for the variation in performance.

DISCUSSION OF RESULTS

The findings presented in Table 1 reveal that female Computer Science Education pre-service teachers recorded a slightly higher posttest performance mean score in lesson planning than their male counterparts in the experimental group. The slightly higher posttest performance mean score obtained by the female pre-service teachers may suggest that they were able to utilise the support provided by GAI tools effectively in carrying out lesson planning tasks. However, the small mean difference of 1.06 suggests that the observed advantage of female pre-service teachers was relatively modest and should not be interpreted as evidence of a substantial gender-based difference in lesson planning performance. This finding agrees with the studies of Ayanwale and Olatunji (2023) and Ogunyemi and Adebayo (2024), who reported that GAI can improve pre-service teachers' instructional planning skills, pedagogical preparedness, and creativity regardless of learner characteristics. Similarly, Sengar, Hasan, Kumar, and Carroll (2025) observed that GAI-supported instructional design enhances lesson preparation by assisting teachers in generating instructional content, refining lesson structure, and improving instructional decision-making.

The finding may also be explained by the potential of GAI to provide similar instructional support to users regardless of gender. When male and female pre-service teachers are exposed to the same GAI tools and given similar opportunities to engage in lesson planning activities, both groups may benefit from the technology's ability to generate ideas, organise information, provide examples, and support the development and refinement of lesson plans. The relatively close posttest mean scores observed in the study suggest that GAI-supported lesson planning may provide comparable opportunities for male and female pre-service teachers to develop their lesson planning performance. This finding is also consistent with UNESCO (2024), which emphasised that AI-supported teaching tools have the potential to provide equitable learning opportunities when users have comparable access, digital competence, and instructional support.

The result in Table 2 revealed that the difference between the male and female pre-service teachers was not statistically significant. Therefore, although the female pre-service teachers obtained a slightly higher posttest mean score than their male counterparts, the difference was not sufficiently large to establish a statistically significant gender effect on lesson planning performance. The non-significant ANCOVA result further indicates that the observed 1.06-point mean difference between the male and female pre-service teachers may be due to random variation within the sample rather than a systematic difference associated with gender. This suggests that male and female Computer Science Education pre-service teachers demonstrated broadly comparable levels of lesson planning performance after exposure to GAI. This finding is important because it indicates that the effectiveness of GAI-supported lesson planning was not

significantly dependent on whether the pre-service teacher was male or female. Rather, GAI-supported lesson planning appears to have provided a similar learning experience for both gender groups. This finding corroborates the work of Zawacki-Richter, Bond, and Bozkurt (2024), who concluded that when AI tools are integrated into instructional activities under similar learning conditions, differences in learning outcomes are more strongly associated with instructional design and learner engagement than with gender. Likewise, Kasneci et al. (2024) argued that the educational value of generative AI depends primarily on how learners interact with the technology rather than demographic characteristics.

CONCLUSION AND RECOMMENDATIONS

The study examined the influence of gender on the lesson planning performance of Computer Science Education pre-service teachers exposed to Generative Artificial Intelligence (GAI)-supported lesson planning in universities in North-East Nigeria. The findings revealed that female pre-service teachers recorded a slightly higher posttest performance mean score than their male counterparts following exposure to GAI-supported lesson planning. However, the observed mean difference between the two groups was not statistically significant, indicating that gender did not significantly influence pre-service teachers' lesson planning performance. The findings suggest that GAI-supported lesson planning provides comparable learning opportunities for both male and female pre-service teachers by supporting them in generating instructional objectives, organising lesson content, selecting appropriate teaching strategies, developing learning activities, and designing assessment tasks. Based on these findings, the study makes the following recommendations:

1. Universities in North-East Nigeria need to ensure equitable access to GAI tools, digital devices, reliable internet connectivity, and other supporting technological facilities to enable pre-service teachers benefit from GAI-supported lesson planning.
2. Lecturers need to provide equal opportunities for both male and female pre-service teachers to participate in GAI-supported lesson-planning activities without gender-base.

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