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ChatGPT-Assisted Instruction for Conceptual Change Among Pre-Service Business and Computer Education Teachers

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Abstract: The increasing use of generative artificial intelligence (GenAI) in higher education has created opportunities for interactive learning while raising questions about its effectiveness in facilitating meaningful learning. This study investigated the effectiveness of lecturer-guided ChatGPT-assisted instruction in supporting conceptual change among pre-service Business and Computer Education teachers in Colleges of Education in North-Central Nigeria. A mixed-method quasi-experimental design involving 150 NCE II students from three Colleges of Education was employed. Intact classes comprising 75 students each in experimental and control groups participated in an eight-week intervention. The experimental group received lecturer-guided ChatGPT-assisted instruction, while the control group received conventional instruction. Data were collected using a 40-item Conceptual Change Achievement Test (KR-20 = 0.87), ChatGPT Perception Questionnaire (Cronbach's α = 0.82), and semi-structured interviews with six lecturers. Quantitative data were analysed using descriptive statistics and ANCOVA, while interview data were analysed thematically. The experimental group recorded a greater mean gain than the control group (15.29 vs. 10.21). ANCOVA showed a significant effect of instructional group on post-test conceptual change scores after controlling for pre-test scores, $F(1,147) = 76.12$, $p < .001$, partial $\eta^2 = .340$. Moreover, 68.0% of experimental-group students transitioned from misconception to correct conception, compared with 42.7% in the control group. Students reported generally positive perceptions, particularly regarding asking questions, identifying misconceptions, and reconsidering previous ideas with lecturer guidance, while lecturers reported improved engagement and conceptual reasoning alongside challenges related to AI accuracy, connectivity, and AI literacy. The study concludes that lecturer-guided ChatGPT-assisted instruction can support conceptual change when integrated within a structured pedagogical framework and recommends responsible, lecturer-supervised use of ChatGPT in teacher education.

Keywords: *ChatGPT, Generative Artificial Intelligence, Conceptual Change, Business Education, Computer Education, Teacher Education.*

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I. INTRODUCTION

Generative artificial intelligence (GenAI) is increasingly used in higher education to support personalised instruction, interactive learning, immediate feedback, and access to diverse explanations. ChatGPT has attracted particular attention because it can generate responses, provide explanations, facilitate dialogue, and support learning activities (Holmes et al., 2022; Kasneci et al., 2023; Lo, 2023). These capabilities have encouraged its use as a support for learner-centred instruction, although it is expected to complement rather than replace educators. Concerns about inaccurate AI-generated information also underscore the need for human oversight (Kasneci et al., 2023; UNESCO, 2023).

Empirical studies have examined ChatGPT in teacher education and Computer Education. Cai et al. (2025) used a quasi-experimental design with 48 pre-service teachers in Eastern China to examine ChatGPT-supported lesson-plan critiques. The study found improved lesson-planning skills, although benefits varied by critique type and prior knowledge. Similarly, Mohammed et al. (2025) used a repeated-measures design with 68 first-year Computer Education undergraduates in Nigeria and found significant improvement in achievement following ChatGPT use ($F(3,201) = 408.793$, $p < .001$, partial $\eta^2 = .859$). These findings indicate that ChatGPT can support teacher learning and academic achievement when integrated into structured educational activities. However, improved achievement does not necessarily demonstrate changes in learners' existing conceptions.

Conceptual change involves the modification, restructuring, or replacement of existing conceptions, particularly where learners hold alternative or incomplete explanations (Posner et al., 1982; Vosniadou, 2013). Posner

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et al. (1982) proposed that conceptual change involves dissatisfaction with existing conceptions and adoption of explanations that are intelligible, plausible, and fruitful, while Vosniadou (2013) described it as the gradual restructuring of mental models through interaction with new knowledge. ChatGPT may support these processes by enabling learners to ask questions, seek clarification, examine alternative explanations, and receive immediate feedback (Kasneci et al., 2023; Lo, 2023). However, inaccurate or incomplete AI-generated responses make lecturer guidance important for structuring interaction, promoting critical questioning, and verifying information (Kasneci et al., 2023; UNESCO, 2023).

This issue is particularly relevant to pre-service Business and Computer Education teachers, who require accurate disciplinary knowledge and the ability to recognise misconceptions and critically evaluate digital information. Both programmes prepare future teachers to integrate digital technologies, information management, and problem-solving into classroom practice. Despite growing research on ChatGPT, comparatively little empirical attention has been given to conceptual change among pre-service Business and Computer Education teachers in Colleges of Education. The present study therefore investigated the effectiveness of lecturer-guided ChatGPT-assisted instruction in supporting conceptual change among NCE II pre-service Business and Computer Education teachers in three Colleges of Education in North-Central Nigeria, while also examining students' perceptions and lecturers' experiences.

➢ *Statement of the Problem*

The specific problem addressed in this study is the persistence of alternative or incomplete conceptions among pre-service Business and Computer Education teachers and the limited evidence on instructional approaches capable of facilitating conceptual change. These teachers are prepared to explain concepts involving information, digital technologies, computer applications, and related practices; unresolved misconceptions may therefore affect their ability to explain concepts accurately and recognise similar misconceptions among future learners. Conceptual change requires learners to modify, reorganise, or replace existing conceptions when confronted with more adequate explanations (Posner et al., 1982; Vosniadou, 2013). Thus, the problem is not simply whether pre-service teachers acquire new information, but whether instruction facilitates substantive changes in their existing conceptions.

Previous technology-supported and ChatGPT-assisted approaches have reported improvements in engagement, interest, perceptions, and academic achievement (Gidado & Zubair, 2025; Lo, 2023; Njoku & Njoku, 2025). However, such outcomes provide limited evidence that learners' existing conceptions have been restructured. Although ChatGPT can provide alternative explanations and immediate responses, inaccurate or incomplete AI-generated information makes unguided use problematic (Kasneci et al., 2023). The educational value of ChatGPT may therefore depend on how lecturers structure and guide students' interaction with the technology. Limited empirical attention to conceptual change in ChatGPT-assisted instruction, particularly among pre-service Business and Computer Education teachers in Colleges of Education, represents a specific unresolved problem.

If unaddressed, unresolved alternative conceptions may affect pre-service teachers' ability to explain concepts accurately, recognise misconceptions, and critically evaluate information obtained through emerging technologies (Posner et al., 1982; Vosniadou, 2013). There is therefore a need for evidence on an instructional approach that combines ChatGPT's interactive capabilities with deliberate lecturer guidance and critical evaluation. This study addresses this gap by investigating lecturer-guided ChatGPT-assisted instruction among NCE II pre-service Business and Computer Education teachers in three Colleges of Education in North-Central Nigeria.

➢ *Aim and Objectives of the Study*

The study investigated the effectiveness of lecturer-guided ChatGPT-assisted instruction in supporting conceptual change among pre-service Business and Computer Education teachers in Colleges of Education in North-Central Nigeria. The objectives are to:

- Determine the effect of lecturer-guided ChatGPT-assisted instruction on conceptual change among pre-service Business and Computer Education teachers compared with conventional instruction.
- Examine pre-service Business and Computer Education teachers' perceptions of lecturer-guided ChatGPT-assisted instruction as an approach for supporting conceptual change.
- Explore lecturers' experiences of implementing lecturer-guided ChatGPT-assisted instruction to support conceptual change among pre-service Business and Computer Education teachers.

➢ *Research Questions*

- What is the effect of lecturer-guided ChatGPT-assisted instruction on conceptual change among pre-service Business and Computer Education teachers compared with conventional instruction?
- What are the perceptions of pre-service Business and Computer Education teachers regarding lecturer-guided ChatGPT-assisted instruction as an approach for supporting conceptual change?
- What are lecturers' experiences of implementing lecturer-guided ChatGPT-assisted instruction to support conceptual change among pre-service Business and Computer Education teachers?

➢ *Research Hypothesis*

- H_{01}: There is no statistically significant difference in conceptual change between pre-service Business and Computer Education teachers who receive lecturer-guided ChatGPT-assisted instruction and those who receive conventional instruction.

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II. METHODOLOGY

This study employed a mixed-method quasi-experimental design using a non-equivalent pre-test–post-test control-group approach. The quantitative component examined the effect of lecturer-guided ChatGPT-assisted instruction on conceptual change and students' perceptions, while the qualitative component explored lecturers' experiences. Intact classes were used because individual randomisation was not practicable within the existing academic structure (Creswell & Creswell, 2018). The intervention lasted eight weeks and was conducted during the 2024/2025 academic session in three Colleges of Education in North-Central Nigeria offering Business Education and Computer Education programmes. The participants comprised 150 NCE II pre-service teachers, with 75 in the experimental group and 75 in the control group. A multi-stage purposive sampling procedure was used to select the Colleges of Education and intact classes. NCE II students were selected because computer networking was relevant to their professional preparation in both programmes. For Business Education students, this relevance included the use of digital technologies, information systems, computer applications, and networked communication in business and educational environments. Students in both programmes received the same instruction and assessment on networking fundamentals, network types, topologies, network devices, transmission media, Internet and intranet concepts, and communication protocols. Both programmes were represented in the experimental and control groups; the experimental group received lecturer-guided ChatGPT-assisted instruction, while the control group received conventional instruction covering the same objectives, content, contact hours, and assessment activities.

The intervention involved lecturer introduction of the concepts, followed by structured ChatGPT activities in which experimental-group students explored concepts, asked questions, examined alternative explanations, identified possible misconceptions, and obtained feedback. The lecturer monitored interactions, facilitated discussion, and encouraged verification of AI-generated responses. Three instruments were used: the 40-item Conceptual Change Achievement Test (CCAT), ChatGPT Perception Questionnaire (CPQ), and Semi-Structured Interview Guide (SSIG). The CCAT covered eight areas of computer networking and targeted identified misconceptions; correct responses received one mark and incorrect or unanswered responses received zero. Conceptual change was assessed using pre-test/post-test CCAT scores, changes in targeted misconceptions, and transitions between pre-test and post-test conceptions. The CPQ was administered to experimental-group students after the intervention and had a Cronbach's alpha of 0.82, while the SSIG was used with six lecturers.

The CCAT was expert-validated and yielded a KR-20 reliability coefficient of 0.87. Quantitative data were analysed using descriptive statistics and ANCOVA, with pre-test CCAT scores as the covariate and post-test scores as the dependent variable; CPQ responses were summarised using means and standard deviations. Interview data were analysed thematically following Braun and Clarke (2006). Statistical significance was tested at the 0.05 level.

III. RESULTS

The results are presented according to the three research questions.

- RQ1: What is the effect of lecturer-guided ChatGPT-assisted instruction on conceptual change among pre-service Business and Computer Education teachers compared with conventional instruction?

Table 1 Pre-Test and Post-Test CCAT Scores by Instructional Group

Group	N	Pre-test M	Pre-test SD	Post-test M	Post-test SD	Mean Gain
Experimental	75	16.87	4.12	32.16	3.76	15.29
Control	75	16.73	4.25	26.94	4.18	10.21
Total	150	16.8	4.18	29.55	4.65	12.75

Table 1 shows comparable pre-test means for the experimental (M = 16.87) and control (M = 16.73) groups, indicating that the groups had similar levels of conceptual understanding before the intervention. After the intervention, the experimental group recorded a higher post-test mean (M = 32.16) and a greater mean gain (15.29) than the control group, which recorded a post-test mean of 26.94 and a mean gain of 10.21. This difference indicates greater improvement in conceptual change among students who received lecturer-guided ChatGPT-assisted instruction. The statistical significance of this difference was subsequently examined using ANCOVA.

Table 2 Changes in Targeted Misconceptions Before and After the Intervention

Targeted misconception	Experimental Pre	Experimental Post	Control Pre	Control Post
Wi-Fi is the Internet	47 (62.7%)	13 (17.3%)	46 (61.3%)	31 (41.3%)
Internet = Web	39 (52.0%)	11 (14.7%)	40 (53.3%)	28 (37.3%)
LAN cannot access Internet	43 (57.3%)	12 (16.0%)	42 (56.0%)	29 (38.7%)
Router = modem	38 (50.7%)	13 (17.3%)	39 (52.0%)	27 (36.0%)
Server = large-storage computer	34 (45.3%)	10 (13.3%)	33 (44.0%)	23 (30.7%)
Protocol = physical device	31 (41.3%)	9 (12.0%)	30 (40.0%)	22 (29.3%)
Wireless requires no equipment	35 (46.7%)	10 (13.3%)	36 (48.0%)	25 (33.3%)

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Table 2 shows substantial reductions in the seven targeted misconceptions presented in the table for the experimental group. For example, the misconception that Wi-Fi is the Internet declined from 62.7% to 17.3%, while Internet = Web declined from 52.0% to 14.7%. Reductions were also observed in the control group, but the post-test proportions remained higher across all seven misconceptions. These findings indicate that lecturer-guided ChatGPT-assisted instruction was associated with a greater reduction in students' targeted misconceptions than conventional instruction, suggesting that the intervention supported the restructuring of students' existing conceptions.

Table 3 Conceptual Transitions by Instructional Group

Conceptual transition	Experimental n (%)	Control n (%)
Misconception → Correct	51 (68.0%)	32 (42.7%)
Correct → Correct	16 (21.3%)	18 (24.0%)
Misconception → Misconception	5 (6.7%)	17 (22.7%)
Correct → Misconception	1 (1.3%)	3 (4.0%)
Other → Correct/Other	2 (2.7%)	5 (6.7%)
Total	75 (100%)	75 (100%)

Table 3 shows that 68.0% of experimental-group students moved from misconception to correct conception, compared with 42.7% of control-group students, while persistent misconceptions were lower in the experimental group (6.7%) than in the control group (22.7%). This indicates that lecturer-guided ChatGPT-assisted instruction was associated with greater conceptual restructuring and a lower persistence of misconceptions than conventional instruction.

Table 4 ANCOVA of Post-Test CCAT Scores by Instructional Group

Source	SS	Df	MS	F	p	Partial η^2
Pre-test	186.42	1	186.42	12.84	< .001	.080
Instructional group	1104.68	1	1104.68	76.12	< .001	.340
Error	2132.51	147	14.51			
Total	3423.61	149				

ANCOVA in Table 4 showed that pre-test scores had a significant effect on post-test CCAT scores, $F(1,147) = 12.84$, $p < .001$, partial $\eta^2 = .080$. After controlling for pre-test scores, instructional group had a significant effect on post-test CCAT performance, $F(1,147) = 76.12$, $p < .001$, partial $\eta^2 = .340$. The adjusted post-test means were 32.08 for the experimental group and 27.02 for the control group, giving an adjusted mean difference of 5.06 points. This result indicates that lecturer-guided ChatGPT-assisted instruction had a statistically significant positive effect on students' conceptual change compared with conventional instruction, after controlling for pre-test scores. The null hypothesis was therefore rejected.

- RQ2: What are the perceptions of pre-service Business and Computer Education teachers regarding lecturer-guided ChatGPT-assisted instruction as an approach for supporting conceptual change?

Table 5 Students' Responses to the ChatGPT Perception Questionnaire (CPQ).

No.	Perception item	M	SD	Decision
3	Discussing ChatGPT's explanations with the lecturer helped me rethink some of my previous ideas.	3.25	0.83	Agree
7	I could ask questions about concepts that I did not understand.	3.31	0.77	Agree
9	The lecturer's guidance helped me determine whether ChatGPT's explanations were reliable.	3.35	0.77	Agree
2	The activities helped me identify some of my previous misconceptions.	3.19	0.84	Agree
13	The approach encouraged me to question explanations instead of accepting them automatically.	3.16	0.83	Agree
20	Overall, lecturer-guided ChatGPT-assisted instruction supported my learning.	3.23	0.79	Agree
10	I sometimes found ChatGPT's explanations confusing or different from what the lecturer taught.	2.47	0.87	Disagree
19	I sometimes felt tempted to accept ChatGPT's answer without checking it.	2.53	0.92	Agree

The CPQ results in table 5 indicate generally positive perceptions. The highest means were for lecturer guidance in determining whether ChatGPT explanations were reliable ($M = 3.35$, $SD = 0.77$), the ability to ask questions about difficult concepts ($M = 3.31$, $SD = 0.77$), and discussing ChatGPT explanations with the lecturer to rethink previous ideas ($M = 3.25$, $SD = 0.83$). Students also agreed that the activities helped identify misconceptions ($M = 3.19$) and encouraged questioning rather than automatic acceptance ($M = 3.16$). The remaining positive items had means between 3.01 and 3.23. Students also acknowledged uncertainty about some ChatGPT answers and a temptation to accept answers without checking them, reinforcing the importance of lecturer supervision.

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- RQ3: What are lecturers' experiences of implementing lecturer-guided ChatGPT-assisted instruction to support conceptual change among pre-service Business and Computer Education teachers?

Table 6 Themes Emerging from Lecturers' Experiences

Theme	Summary of findings
Improved conceptual change	Lecturers observed clearer explanations, stronger conceptual reasoning, and greater ability to reconsider previous ideas.
Enhanced learner engagement	Lecturers reported increased participation, curiosity, questioning, and active involvement.
Personalised learning support	Students benefited from immediate explanations, feedback, and opportunities to explore difficult concepts independently.
Implementation challenges	Internet connectivity, occasional inaccurate AI responses, limited AI literacy, and continuing lecturer guidance were identified as challenges.

The thematic analysis indicates in Table 6 that lecturers generally viewed the approach as useful for supporting conceptual change and engagement. They also identified implementation challenges involving connectivity, inaccurate AI-generated responses, and differences in AI literacy. The findings emphasise that ChatGPT functioned most effectively as an instructional support tool within lecturer guidance rather than as a replacement for the lecturer.

IV. DISCUSSION OF FINDINGS

The findings showed that lecturer-guided ChatGPT-assisted instruction was associated with greater conceptual change than conventional instruction. The experimental group recorded a higher post-test mean and greater mean gain, while 68.0% moved from misconception to correct conception compared with 42.7% in the control group. Persistent misconceptions were also less common in the experimental group. ANCOVA confirmed a significant instructional-group effect after controlling for pre-test scores.

These findings are consistent with Conceptual Change Theory, which explains meaningful learning as restructuring existing conceptions when learners encounter explanations that are intelligible, plausible, and fruitful (Posner et al., 1982). Vosniadou (2013) similarly described conceptual change as the gradual restructuring of mental models through interaction with new knowledge. The present findings are relevant to this perspective because the evidence extends beyond higher test scores to reductions in targeted misconceptions and movement from misconception to correct conception. The findings also extend earlier ChatGPT studies that have focused mainly on engagement, interest, perceptions, and academic achievement (Gidado & Zubair, 2025; Lo, 2023; Njoku & Njoku, 2025).

Students' perceptions were also generally positive. They particularly valued lecturer guidance for checking the reliability of ChatGPT responses, asking questions, and reconsidering previous ideas. These perceptions are consistent with the role of dialogue, alternative explanations, and feedback in supporting conceptual restructuring. However, students also acknowledged that some ChatGPT responses were uncertain and that they could be tempted to accept answers without verification. This finding reinforces concerns about AI-generated inaccuracies and supports the need for human oversight and critical evaluation (Kasneci et al., 2023; UNESCO, 2023). Thus, the findings support guided rather than unrestricted use of ChatGPT.

The lecturers' experiences complemented the quantitative findings. They reported improved participation, questioning, conceptual reasoning, and opportunities for personalised support. They also identified connectivity, inaccurate AI responses, and limited AI literacy as challenges. These observations suggest that the effectiveness of ChatGPT-assisted instruction depended on pedagogical guidance rather than access to the technology alone. The lecturer remained responsible for directing interaction, checking information, correcting inaccuracies, and helping students evaluate explanations. This is particularly important in teacher education, where pre-service teachers must develop both disciplinary competence and the professional judgement required to use emerging technologies responsibly.

V. CONCLUSION

The study concludes that lecturer-guided ChatGPT-assisted instruction can support conceptual change among pre-service Business and Computer Education teachers. The experimental group showed greater improvement in CCAT performance, greater reduction in targeted misconceptions, and a higher proportion of misconception-to-correct conceptual transitions than the control group. Students generally perceived the approach positively, while lecturers reported improved engagement and conceptual reasoning but identified AI accuracy, connectivity, and the need for continued lecturer guidance as challenges. The study concludes that the educational value of ChatGPT for conceptual change depends on its structured integration with lecturer guidance, critical evaluation, and purposeful classroom interaction.

RECOMMENDATIONS

- Business and Computer Education lecturers should integrate lecturer-guided ChatGPT-assisted instruction into classroom teaching, particularly when teaching concepts associated with persistent misconceptions.
- Colleges of Education should establish structured guidelines for the pedagogical use of generative AI that emphasise lecturer supervision, verification of AI-

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generated information, and critical evaluation of ChatGPT responses.

- Lecturers should structure ChatGPT-assisted activities to encourage students to question existing conceptions, examine alternative explanations, identify misconceptions, and reconsider previously held ideas.
- Colleges of Education should provide AI-literacy training for lecturers and pre-service teachers to strengthen their effective, critical, and responsible use of generative AI.
- Researchers should conduct further studies on lecturer-guided generative AI-assisted instruction across other subject areas and educational contexts to examine the consistency and generalisability of its effects on conceptual change.

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