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# Effects of Pedagogical Capacity Training Module for Enhancing Lecturers Effective Curriculum Implementation in Federal University of Technology, Minna Niger State

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**ABSTRACT**

*This study investigated the effects of a pedagogical capacity training module on STEM lecturers' attitudes, knowledge, and instructional practices for effective curriculum implementation of 21st-century at the Federal University of Technology, Minna. The study adopted experimental research design, specifically one sample repeated measure design. The population of the study consist all STEM lecturers in the Federal University of Technology, Minna out of which two hundred (200) STEM lecturers were selected using multi-stage sampling techniques and participated in the study. Data were collected using structured questionnaire measuring attitudes toward innovative teaching strategies, 21st-century skill integration, and knowledge of curriculum implementation. The instrument was validated by experts and the internal consistency reliability of the instruments was established, the index was calculated using Cronbach Alpha reliability method and the index was found to be 0.87. Descriptive statistics of mean, SD and percentages were used for analysis. Findings revealed significant improvements in lecturers' adoption of student-centred pedagogies, including problem-based learning, collaborative learning, inquiry-based instruction, and ICT integration. Additionally, lecturers' confidence in applying innovative teaching strategies and their knowledge of curriculum implementation improved substantially. The study concludes that pedagogical capacity training is effective in transforming lecturers' instructional practices and enhancing their readiness to implement competency-based curricula. It recommends sustained professional development, institutional support, and integration of capacity-building programmes into higher education policy frameworks.*

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## INTRODUCTION

In the rapidly evolving educational landscape of the 21st century, the development of critical skills such as creativity, collaboration, communication, problem-solving, and digital literacy has become essential. Teachers play a central role in equipping learners with these competencies, making their knowledge, attitudes, and practices regarding capacity training crucial to effective instruction. Teachers' understanding of innovative pedagogies, their openness to continuous professional development, and the extent to which they apply new instructional strategies directly influence the integration of 21st-century skills in the classroom. Therefore, assessing and enhancing teachers' knowledge, attitudes, and practices towards capacity training is vital for fostering learner-centred environments that support future-ready education.

The increasing complexity of the global knowledge economy has significantly transformed expectations from higher education systems,

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particularly in the development of 21st-century skills such as critical thinking, collaboration, creativity, communication, and digital literacy. These competencies are essential for preparing graduates to function effectively in dynamic and technology-driven environments (Ananiadou & Claro, 2020; van Laar et al., 2020). Consequently, educators, especially STEM lecturers, are expected to adopt innovative pedagogical approaches that promote active learning and skills acquisition rather than traditional content delivery.

Effective curriculum implementation is central to achieving these educational goals. However, research indicates that many educators lack the pedagogical competencies required to translate curriculum objectives into meaningful classroom practices (Fullan, 2020). Traditional teacher-centred approaches still dominate many classrooms, limiting students' opportunities to develop higher-order thinking and problem-solving skills (Darling-Hammond et al., 2020). This underscores the need for continuous professional development through pedagogical capacity training.

Pedagogical capacity training refers to structured professional development programmes designed to enhance teachers' instructional knowledge, skills, and attitudes toward innovative teaching practices. Recent studies have shown that such training improves teachers' self-efficacy, instructional quality, and student learning outcomes (Desimone & Garet, 2021; Darling-Hammond et al., 2020). In STEM education, capacity-building initiatives are particularly important due to the need for inquiry-based, hands-on, and technology-driven instructional strategies. In the Nigerian context, challenges such as inadequate training, limited exposure to modern pedagogies, and insufficient integration of ICT have hindered effective curriculum implementation (Aina, 2021; Eze & Okoli, 2022). As a result, there is a growing emphasis on equipping lecturers with the skills necessary to foster learner-centred environments and promote 21st-century competencies.

Despite the recognized importance of pedagogical training, there is limited empirical evidence on its impact on lecturers' attitudes, knowledge, and practices in Nigerian universities. Therefore, this study examines the effects of a pedagogical capacity training module on STEM lecturers at the Federal University of Technology, Minna, focusing on changes in attitudes toward teaching, adoption of innovative strategies, and knowledge of curriculum implementation. The findings are expected to provide insights into the effectiveness of professional development programmes in enhancing teaching quality and curriculum delivery.

### *Research Objectives*

The main aim of the study is to assess Effects of Pedagogical Capacity Training Module for Enhancing Lecturers Effective Curriculum Implementation in Federal University of Technology, Minna Niger State. The following objectives are set to guide the study:

1. To determine the effects of pedagogical capacity training module on STEM lecturer's attitudes towards teaching to enhance 21st-century skills in Federal University of Technology Minna.
2. To determine the effects of pedagogical capacity training module on STEM lecturers' Attitudes towards Innovative Teaching Strategies.
3. To determine the effects of pedagogical capacity training module on STEM Lecturers' Knowledge on Effective Curriculum Implementation between Baseline and Endline Result.

### *Research Questions*

In line with the stated research objectives, the following research questions were raised to guide the study:

1. What is the difference in the baseline and endline result of STEM lecturer's attitudes towards teaching to enhance 21st-century skills in Federal University of Technology Minna
2. What is the difference in the Lecturers' Attitudes towards Innovative Teaching Strategies between Baseline and Endline Result?

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3. That is the difference in the Lecturers' Knowledge on Effective Curriculum Implementation between Baseline and Endline Result?

## METHODOLOGY

The study adopted experimental research design, specifically one sample repeated measure design. The population of the study consisted of all STEM lecturers in the Federal University of Technology, Minna. A multistage sampling technique was adopted to select the lecturers for this study. Firstly, the university was clustered into existing schools or faculties (9 schools). Secondly, each faculty were clustered based on the number of departments. A proportional sampling technique was used to select 200 lecturers across all the departments.

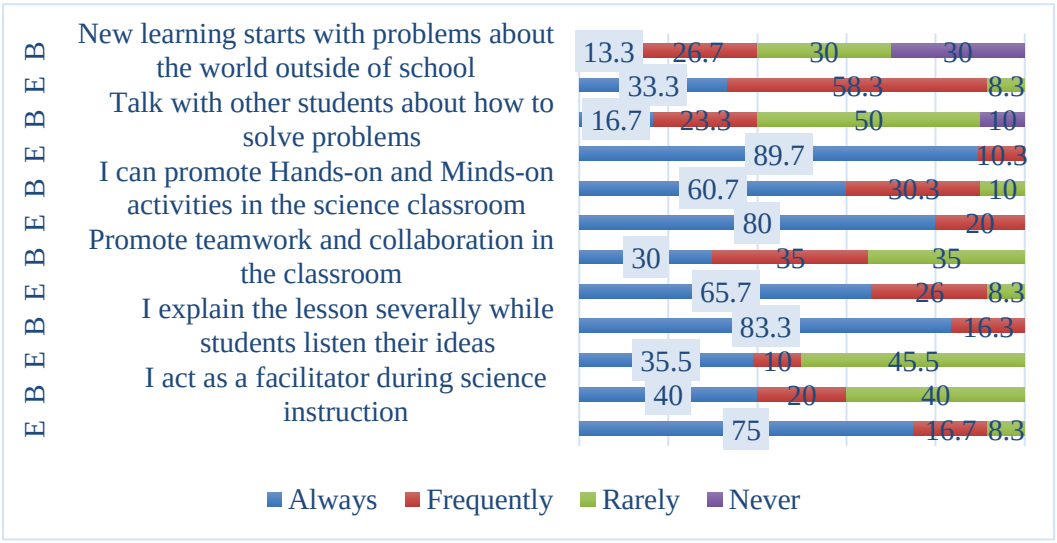
Twenty lecturers were selected each from 10 schools for the training. Data were collected using structured questionnaire measuring attitudes toward innovative teaching strategies, 21st-century skill integration, and knowledge of curriculum implementation. The instrument was validated by experts and the internal consistency reliability of the instruments was established, the index was calculated using Cronbach Alpha reliability method and the index was found to be 0.87.

The data collection began with ethical clearance from the University management and participating lecturers. These critical stakeholders were briefed on the objectives of the study. This followed by the orientation and launch of the project during which the administration of baseline data were collected. The capacity training commenced immediately after the collection of the baseline data and this last for four (4) weeks thereafter, the End line data were collected. Descriptive statistics of mean, SD and percentages were used for analysis.

### Baseline-Endline Science Data Findings

The data collected were analysed using percentages to determine STEM lecturers' attitudes towards teaching to enhance 21st-century skills before and after the capacity training and the findings are presented in Figure 1 and 2.

**Research Question One:** what is the difference in the baseline and endline result of STEM lecturer's attitudes towards teaching to enhance 21st-century skills in Federal University of Technology Minna.




**Key**: B=Baseline, E= Endline

Figure 1: Stacked Bar-chat Comparison of the change in STEM lecturer's attitudes towards teaching to enhance 21st-century skills between Baseline and Endline result in Federal University of Technology Minna

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The data (items 1-6) reflect a significant positive shift in science and mathematics teachers' knowledge and attitudes towards innovative teaching practices aimed at enhancing 21st-century skills from the baseline to the endline. At baseline, only 13.3% of teachers consistently initiated learning with real-world problems, while 30% never did. By the endline, 91.6% (33.3% always and 58.3% frequently) engaged students with real-world problems, reflecting a strong shift towards problem-based learning, which is crucial for critical thinking and problem-solving, core 21st-century skills. A dramatic increase was also observed in collaborative learning: at baseline, only 16.7% of teachers always encouraged students to discuss solutions with peers, but this rose sharply to 89.7% at endline, indicating a strong embrace of student-centred learning strategies.

Furthermore, teachers' ability to promote hands-on and minds-on activities showed considerable improvement. At the baseline, 60.7% of teachers reported always engaging students in practical science learning, increasing to 80% at endline. This implies that more teachers adopted experiential learning techniques that foster creativity and inquiry. Similarly, promoting teamwork and collaboration improved notably, with those always encouraging it increasing from 30% to 65.7%. These findings suggest a growing understanding among teachers of the importance of communication, collaboration, and active participation in nurturing 21st-century competencies.

Conversely, a notable decline was recorded in teacher-centred approaches. At baseline, a dominant 83.3% of teachers reported always explaining lessons repeatedly while students merely listened, suggesting a more traditional, lecture-based method. This dropped significantly to 35.5% at endline, while 45.5% reported never using that approach. This shift coincides with the increase in teachers adopting the facilitator role, from 40% at baseline to 75% at endline—showing a pedagogical transformation toward guiding students to construct their understanding. Altogether, the data demonstrates substantial progress in teachers' attitudes and practices towards fostering active, student-centred, and skills-driven teaching environments.

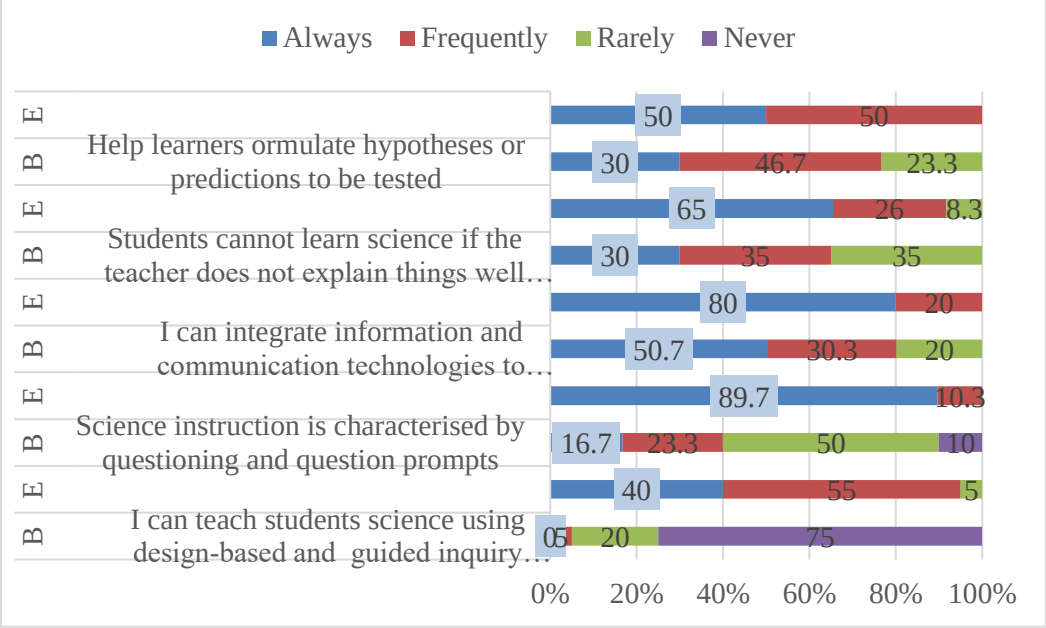


**Figure 2:** Stacked Bar-chat of Lecturers' Attitudes towards Innovative Teaching Strategies between Baseline and Endline Result

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Figure 2 present Lecturers' Attitudes towards Innovative Teaching Strategies between Baseline and Endline Result. The data (items 7-11) reveal significant improvements in STEM lecturer's knowledge and attitudes toward innovative instructional strategies that enhance 21st-century skills from the baseline (B) to the endline (E). One of the most notable shifts is in teachers' support for helping learners formulate hypotheses or predictions to test an essential scientific practice. While at baseline, only 30% of teachers reported always engaging students in this activity, this doubled to 50% at the endline. Similarly, the percentage of teachers who rarely or never engaged students in this practice dropped considerably, indicating a growing embrace of inquiry-based learning.

The perception of the teacher's role in student learning also evolved. At baseline, 65% of respondents agreed that students cannot learn science unless the teacher explains well, reflecting a teacher-centred mindset. However, by the endline, this belief weakened, with only 30% still holding it, and the remaining 70% shifting to "frequently," "rarely," or "never." Furthermore, the ability to integrate Information and Communication Technology (ICT) in instruction rose from 50.7% (always) to 80% at endline, suggesting increased confidence in using digital tools to support active and meaningful science teaching. This is crucial for fostering digital literacy and preparing learners for modern, tech-driven environments.

Teachers also reported improved use of questioning strategies and design-based inquiry approaches. While only 16.7% of teachers said they "always" used questioning techniques during science instruction at baseline, this jumped to 89.7% by the endline, showing a substantial shift towards promoting critical thinking. Perhaps most striking is the jump in those who reported always using design-based and guided inquiry strategies, from just 5% at baseline to 40% at endline. Meanwhile, those who "never" used these strategies dropped from 75% to 5%, marking a transformative improvement in the adoption of learner-centred pedagogies that align with 21st-century learning objectives.

**Research Question Two:** what is the difference in the Lecturers' Attitudes towards Innovative Teaching Strategies between Baseline and Endline Result?

Understanding the attitudes of science and mathematics teachers toward innovative teaching is crucial in assessing the effectiveness of professional development programs aimed at fostering 21st-century skills. Attitudes influence teachers' willingness to adopt new instructional methods, embrace student-centred learning, and integrate real-world problems and technology into their classrooms. Therefore, measuring attitudinal change over time provides valuable insights into the transformation of instructional practices and the readiness of teachers to implement reforms.

This comparison between baseline and endline data explores the shifts in teachers' attitudes toward innovative teaching strategies designed to enhance critical thinking, collaboration, creativity, and problem-solving among students. By examining specific indicators such as the use of inquiry-based learning, facilitation roles, collaboration, and rejection of teacher-dominated instruction, this analysis highlights the extent to which teachers have moved from traditional practices to more progressive, learner-centred approaches.

Table 1: Comparison of Teachers' Attitudes towards Innovative Teaching Strategies between Baseline and Endline

| S/N | ITEM | | SA | A | UD | D | SD |
|---|---|---|---|---|---|---|---|
| 1 | I feel confident using innovative teaching methods such as design-based science instruction well enough to maximize their use in my science classroom | Baseline | 33.0 | 27.0 | 40.0 | | |
| | | Endline | 75 | 25 | | | |
| 2 | I feel confident that I have the skills necessary to use technologies for science instruction | Baseline | 93.3 | 6.7 | | | |
| | | Endline | 83.3 | 16.7 | | | |
| 3 | | Baseline | 20 | 46.7 | 23.3 | 10 | |

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| S/N | ITEM | | SA | A | UD | D | SD |
|---|---|---|---|---|---|---|---|
| | I can successfully teach relevant science content with the appropriate use of technology | Endline | 55 | 45 | | | |
| 4 | I am confident in my ability to continually link science instruction to real-life scenarios | Baseline | 30.7 | 50.3 | 20 | | |
| | | Endline | 41.7 | 58.3 | | | |
| 5 | I can help students engage effectively in collaborative and group work during science instruction | Baseline | 26.7 | 33.3 | 40 | | |
| | | Endline | 50 | 50 | | | |
| 6 | I can effectively monitor and facilitate students' hands-on and minds-on activities during science instruction in my classroom | Baseline | 30.2 | 30.8 | 10 | 30 | |
| | | Endline | 40.6 | 50.2 | 9.2 | | |
| 7 | I can motivate my students to participate actively in science lessons using Innovative instructions | Baseline | 35.0 | 50.3 | 14.7 | | |
| | | Endline | 42.7 | 57.3 | | | |
| 8 | I feel confident that I can develop creative ways to teach science using local resources | Baseline | 50.0 | 45.5 | 4.5 | | |
| | | Endline | 55.0 | 45.0 | | | |
| 9 | I can engage students in open-ended problem-solving and help them generate ideas in the science classroom | Baseline | | 10.2 | 40.5 | 40.0 | 9.3 |
| | | Endline | 56.4 | 40.6 | 4.0 | | |
| 10 | I feel confident about selecting appropriate scaffolds such as question prompts and questioning to improve science instruction | Baseline | 30.0 | 50.0 | 20 | | |
| | | Endline | 50.7 | 49.3 | | | |

The data shows a significant increase in science and mathematics teachers' self-efficacy regarding innovative teaching approaches to support 21st-century skill development from the baseline to the endline. For instance, the percentage of teachers who *strongly agreed* (SA) that they feel confident using innovative methods such as design-based instruction rose from 33% to 75%. Similarly, their confidence in teaching science content using appropriate technology improved markedly, with SA responses increasing from 20% to 55%. Although there was a slight decline in the number of teachers who felt confident in their general ability to use technology for science instruction (from 93.3% to 83.3%), the data overall suggest growing confidence in applying technology in more integrated and pedagogically relevant ways.

There were also substantial improvements in teachers' perceived ability to link science instruction to real-life situations, manage hands-on and minds-on activities, and facilitate collaborative learning which are three critical features of 21st-century teaching. For example, confidence in linking science to real-life scenarios increased from a combined SA and A of 81% to a full 100% at endline. Teachers' ability to monitor and facilitate student-centred learning activities also improved: the proportion of SA responses rose from 30.2% to 40.6%, while A responses jumped from 30.8% to 50.2%. Notably, the belief in their ability to help students collaborate effectively rose from 60% (combined SA and A) to 100%, showing a strong shift toward collaborative and participatory instruction.

Additionally, teachers demonstrated a remarkable increase in confidence in problem-solving and higher-order instructional strategies. At baseline, 49.8% of teachers disagreed or strongly disagreed that they could engage students in open-ended problem-solving. By endline, this reversed, with 97% either strongly agreeing (56.4%) or agreeing (40.6%). Confidence in using scaffolds like questioning also improved, with SA responses rising from 30% to 50.7%. These shifts collectively highlight a transition from uncertainty or passive teaching approaches toward a more proactive, student-centred, and skill-oriented teaching philosophy. This growth in self-efficacy is foundational for sustaining long-term instructional reform and equipping learners with the critical thinking and problem-solving skills essential in today's world.

**Research Question Three:** hat is the difference in the Lecturers' Knowledge on Effective Curriculum Implementation between Baseline and Endline Result?

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Table 2: Baseline and Endline Result for Lecturers' Knowledge on Effective Curriculum Implementation

| S/N | Items | | SA | A | UD | D | SD |
|---|---|---|---|---|---|---|---|
| | **Curriculum Content Knowledge** | | | | | | |
| 1 | I have a clear understanding of the objectives of the curriculum I teach | Baseline | 33.0 | 27.0 | 40.0 | | |
| | | Endline | 75 | 25 | | | |
| 2 | I understand how to interpret curriculum documents effectively. | Baseline | 93.3 | 6.7 | | | |
| | | Endline | 83.3 | 16.7 | | | |
| 3 | I understand how to sequence lessons according to curriculum guidelines | Baseline | 20 | 46.7 | 23.3 | 10 | |
| | | Endline | 55 | 45 | | | |
| 4 | I am familiar with the content and structure of the curriculum. | Baseline | 30.7 | 50.3 | 20 | | |
| | | Endline | 41.7 | 58.3 | | | |
| 5 | I am aware of current updates or changes in the curriculum. | Baseline | 26.7 | 33.3 | 40 | | |
| | | Endline | 50 | 50 | | | |
| 6 | I have a clear understanding of the objectives of the curriculum I teach. | Baseline | 30.2 | 30.8 | 10 | 30 | |
| | | Endline | 40.6 | 50.2 | 9.2 | | |
| | **Assessment Techniques** | | | | | | |
| 7 | I understand how to monitor students' progress based on curriculum standards. | Baseline | 35.0 | 50.3 | 14.7 | | |
| | | Endline | 42.7 | 57.3 | | | |
| 8 | I am familiar with curriculum evaluation and feedback processes. | Baseline | 50.0 | 45.5 | 4.5 | | |
| | | Endline | 55.0 | 45.0 | | | |
| 9 | I understand how to design tests aligned with curriculum objectives. | Baseline | | 10.2 | 40.5 | 40.0 | 9.3 |
| | | Endline | 56.4 | 40.6 | 4.0 | | |
| 10 | I understand how to use assessment results to improve teaching | Baseline | 30.0 | 50.0 | 20 | | |
| | | Endline | 50.7 | 49.3 | | | |
| | **Instructional Materials & Classroom Management** | | | | | | |
| 11 | I understand how to develop instructional materials based on the curriculum. | Baseline | 50.0 | 45.5 | 4.5 | | |
| | | Endline | 55.0 | 45.0 | | | |
| 12 | I understand how to manage time effectively during lesson delivery | Baseline | | 10.2 | 40.5 | 40.0 | 9.3 |
| | | Endline | 56.4 | 40.6 | 4.0 | | |
| 13 | I have adequate knowledge of classroom management strategies. | Baseline | 30.0 | 50.0 | 20 | | |
| | | Endline | 50.7 | 49.3 | | | |
| | **Pedagogical Knowledge** | | | | | | |
| 14 | I understand how to align lesson objectives with curriculum goals. | Baseline | 33.0 | 27.0 | 40.0 | | |
| | | Endline | 75 | 25 | | | |
| 15 | I understand the recommended teaching methods for implementing the curriculum. | Baseline | 93.3 | 6.7 | | | |
| | | Endline | 83.3 | 16.7 | | | |
| 16 | I am knowledgeable about learner-centered instructional strategies. | Baseline | 20 | 46.7 | 23.3 | 10 | |
| | | Endline | 55 | 45 | | | |
| 17 | I understand how to adapt the curriculum to meet diverse learners' needs. | Baseline | 30.7 | 50.3 | 20 | | |
| | | Endline | 41.7 | 58.3 | | | |
| 18 | I understand how to set measurable learning outcomes. | Baseline | 26.7 | 33.3 | 40 | | |
| | | Endline | 50 | 50 | | | |
| 19 | | Baseline | 30.2 | 30.8 | 10 | 30 | |

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| S/N | Items | | SA | A | UD | D | SD |
|---|---|---|---|---|---|---|---|
| | I can facilitate collaborative learning and group project | Endline | 40.6 | 50.2 | 9.2 | | |

The data presented in Table 2 reveal a substantial improvement in teachers' knowledge across key domains of curriculum implementation from baseline to end line, indicating the positive impact of the training intervention. Overall, there is a consistent shift from moderate and low levels of agreement (A, UD, D, SD) at baseline to stronger agreement (SA and A) at endline across all categories, suggesting enhanced teacher competence and confidence.

The findings show a marked improvement in teachers' understanding of curriculum content. For example, the proportion of teachers who strongly agreed that they have a clear understanding of curriculum objectives increased significantly from 33.0% at baseline to 75% at endline, while uncertainty (UD) was completely eliminated. Similarly, teachers' ability to interpret curriculum documents, sequence lessons appropriately, and understand curriculum structure improved notably, with most responses concentrated in SA and A at endline. Awareness of curriculum updates also improved substantially, with combined SA and A responses rising from 60% at baseline to 100% at endline, indicating that teachers became more informed and up-to-date with curriculum changes. These trends suggest that the training enhanced teachers' foundational understanding of curriculum design and expectations.

Significant gains were also recorded in teachers' knowledge of assessment practices. Teachers' understanding of how to monitor students' progress improved from a combined 85.3% (SA and A) at baseline to 100% at endline, demonstrating strengthened competence in tracking learning outcomes. In addition, knowledge of test design aligned with curriculum objectives showed a dramatic shift. At baseline, a large proportion (49.3%) of teachers disagreed or strongly disagreed with their ability in this area. However, at endline, this reversed significantly, with 97% of teachers agreeing or strongly agreeing, indicating a major improvement in assessment literacy. Similarly, teachers' ability to use assessment results to improve instruction increased from 80% to 100% (SA and A combined), reflecting a stronger orientation toward data-driven teaching and continuous improvement.

The data further indicate improvements in teachers' ability to develop instructional materials and manage classroom processes effectively. For instance, knowledge of instructional material development increased slightly but remained high overall, moving from 95.5% to 100% (SA and A combined). More striking improvements were observed in time management during lesson delivery. At baseline, nearly half of the teachers (49.3%) expressed disagreement, but by endline, this shifted dramatically, with 97% expressing agreement, showing enhanced classroom efficiency. Teachers' knowledge of classroom management strategies also improved from 80% to 100% (SA and A combined), indicating stronger control and organization of the learning environment.

The results demonstrate significant growth in pedagogical knowledge, particularly in learner-centred teaching approaches. Teachers' understanding of aligning lesson objectives with curriculum goals increased from 60% to 100% (SA and A combined), indicating improved instructional planning skills. Knowledge of learner-centred strategies and adapting instruction for diverse learners also showed strong improvement, with SA responses increasing notably and all uncertainty eliminated at endline. This reflects a shift toward inclusive and student-focused teaching practices. Furthermore, teachers' ability to set measurable learning outcomes and facilitate collaborative learning improved significantly. For example, the ability to support collaborative learning rose from a mixed distribution at baseline (including 30% disagreement) to over 90% agreement at endline, indicating a transition toward more interactive and participatory teaching methods.

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In general, the data reveal a clear and consistent positive transformation in teachers' knowledge of curriculum implementation following the intervention. Across all domains, curriculum content, assessment, instructional materials, classroom management, and pedagogy, teachers moved from moderate understanding and occasional uncertainty to strong confidence and competence. This suggests that the training program was highly effective in equipping teachers with the necessary knowledge and skills to implement the curriculum more effectively, ultimately supporting improved teaching quality and better learning outcomes aligned with 21st-century educational goals.

## DISCUSSION OF FINDINGS

The findings of this study reveal a substantial transformation in STEM lecturers' attitudes and instructional practices following participation in the pedagogical capacity training module. One of the most notable outcomes is the significant shift from teacher-centred to student-centred pedagogies. At baseline, a large proportion of lecturers relied on lecture-based instruction, but this declined considerably at the endline, with increased adoption of facilitation roles. This aligns with contemporary constructivist learning perspectives, which emphasize active student engagement in knowledge construction (Schunk, 2020; Eze & Okoli, 2022).

The improvement in lecturers' use of real-world problem-solving strategies and collaborative learning indicates a strong alignment with 21st-century teaching frameworks. The dramatic increase in the use of problem-based learning and peer discussion reflects enhanced capacity to promote critical thinking and teamwork among students. These findings corroborate recent studies that highlight the effectiveness of professional development programmes in promoting inquiry-based and collaborative teaching practices (Desimone & Garet, 2021).

Furthermore, the study revealed significant gains in lecturers' integration of ICT in instruction. The increase in confidence and actual use of digital tools suggests that the training successfully addressed gaps in digital literacy. This is particularly important in contemporary education, where technology plays a critical role in enhancing teaching and learning processes (Koehler et al., 2022). The findings support recent research indicating that targeted training improves teachers' ability to integrate technology meaningfully into their pedagogy (Tondeur et al., 2021). Another key finding is the improvement in lecturers' self-efficacy regarding innovative teaching strategies. The increase in confidence in using design-based instruction, scaffolding techniques, and open-ended problem-solving demonstrates a shift toward higher-order instructional practices. Teacher self-efficacy remains a crucial determinant of instructional effectiveness, as confident teachers are more likely to experiment with new methods and sustain instructional innovations.

In terms of curriculum implementation, the study found significant improvements in lecturers' knowledge across multiple domains, including curriculum interpretation, lesson sequencing, assessment practices, and instructional material development. This suggests that the training not only influenced attitudes and practices but also enhanced cognitive understanding of curriculum processes. Effective curriculum implementation requires both pedagogical skills and content knowledge, and the observed improvements indicate a holistic impact of the training programme (Fullan, 2020; Eze & Okoli, 2022). Overall, the findings demonstrate that pedagogical capacity training can lead to meaningful and measurable improvements in lecturers' teaching practices, attitudes, and knowledge. The consistency of positive changes across multiple indicators suggests that such interventions are effective in promoting sustainable instructional reform.

## CONCLUSION

The study concludes that pedagogical capacity training has a significant positive effect on STEM lecturers' attitudes, instructional practices, and knowledge of effective curriculum implementation. The transition from traditional, teacher-centred approaches to innovative, learner-centred strategies highlights the

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effectiveness of the training programme in aligning teaching practices with 21st-century educational demands.

The improvement in lecturers' confidence, use of ICT, and ability to engage students in higher-order thinking activities demonstrates that capacity-building initiatives are essential for enhancing teaching quality in higher education. Additionally, the findings underscore the importance of continuous professional development in ensuring that educators remain responsive to evolving educational trends and student needs. Ultimately, the study affirms that investing in pedagogical capacity development is critical for achieving effective curriculum implementation and fostering the development of future-ready graduates.

## RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made:

1. Universities should integrate pedagogical capacity training into regular staff development programmes to ensure continuous improvement in teaching practices.
2. Training programmes should emphasize inquiry-based, problem-based, and collaborative learning strategies to promote 21st-century skills.
3. Regular assessment of lecturers' instructional practices should be conducted to ensure sustained implementation of innovative teaching strategies.
4. Educational policymakers should prioritize funding and support for professional development initiatives aimed at improving curriculum implementation.
5. Capacity-building initiatives should be designed to address the specific needs of lecturers based on discipline, experience, and instructional challenges.

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## REFERENCES

Aina, J. K. (2021). Challenges of science teaching in Nigerian schools. African Journal of Educational Studies, 9(2), 45–56.

Ananiadou, K., & Claro, M. (2020). 21st century skills and competences for new millennium learners. OECD Education Working Papers, 41, 1–33.

Darling-Hammond, L., Hyler, M. E., & Gardner, M. (2020). Effective teacher professional development. Learning Policy Institute.

Desimone, L. M., & Garet, M. S. (2021). Best practices in teachers' professional development in the United States. Psychology, Society & Education, 13(1), 1–16.

Eze, T. I., & Okoli, J. N. (2022). Teacher capacity building and curriculum implementation in Nigerian secondary schools. Journal of Educational Research and Practice, 12(3), 112–125.

Fullan, M. (2020). Leading in a culture of change (2nd ed.). Jossey-Bass.

Koehler, M. J., Mishra, P., & Cain, W. (2022). What is technological pedagogical content knowledge (TPACK)? Journal of Education, 193(3), 13–19.

Schunk, D. H. (2020). Learning theories: An educational perspective (8th ed.). Pearson.

Tondeur, J., Scherer, R., Siddiq, F., & Baran, E. (2021). A comprehensive analysis of preservice teachers' ICT competencies. Computers & Education, 156, 103941.

Van Laar, E., van Deursen, A. J., van Dijk, J. A., & de Haan, J. (2020). The relation between 21st-century skills and digital skills. Computers in Human Behavior, 72, 577–588.

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