



EXPLORING THE RELATIONSHIPS BETWEEN TEACHERS' TECHNOLOGICAL PEDAGOGICAL CONTENT KNOWLEDGE (TPACK) AND THEIR PERFORMANCE IN THREE SELECTED PUBLIC UNIVERSITIES OF LIBERIA

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ABSTRACT

This explanatory mixed-methods study investigates the relationship between Technological Pedagogical Content Knowledge (TPACK) and teachers' performance at three selected public universities in Liberia. Grounded in the frameworks developed by Mishra & Koehler (2006) and Lee Shulman (1986, 1987), the research examines how the seven core domains of TPACK, Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Knowledge (TK), Pedagogical Content Knowledge (PCK), Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK), and integrated TPACK relate to teaching effectiveness. The study adopts a sequential explanatory design, combining quantitative survey data from 245 respondents and qualitative insights from semi-structured interviews. Descriptive and inferential statistical tools, including Pearson's correlation and multiple regression analysis, are employed to test the hypothesis that no significant relationship exists between TPACK and teacher performance. The findings reveal that while teachers demonstrate strong proficiency in content and pedagogical knowledge, their technological competencies remain limited, constrained by infrastructural deficits, resource scarcity, and limited professional development opportunities. Results confirm a significant positive association between overall TPACK competency and teaching performance, with integrated TPACK and PCK emerging as the strongest predictors of effectiveness. Qualitative data highlight challenges such as unstable power supply, limited access to digital tools, and inadequate training, while also identifying adaptive strategies used to deliver quality instruction despite constraints. This research addresses a critical gap in global literature, which has largely focused on developed nations, by providing context-specific evidence from a resource-constrained setting. The findings offer actionable insights for policymakers, university administrators, and educators, supporting the design of targeted training programs and policy interventions to enhance teaching quality and learning outcomes in Liberian higher education.

Keywords: TPACK, Teachers' Performance, Liberian Universities, Higher Education, Educational Technology

INTRODUCTION

The integration of technology into education has evolved from a supplementary resource to a fundamental component of modern

teaching and learning. From an initial focus on basic computer literacy, the emphasis has shifted toward the ability to critically evaluate, adapt, and utilize digital tools to improve instructional quality and student outcomes. This evolution has given

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rise to the TPACK framework, introduced by Mishra & Koehler (2006), which posits that effective technology integration requires more than technical skills; it demands the ability to blend content expertise, teaching strategies, and technological tools in a contextually appropriate manner.

Globally, TPACK is recognized as a core competency for 21st-century educators, directly linked to instructional innovation, student engagement, and academic success. However, the application and impact of this framework vary widely across contexts. In developing nations like Liberia, the educational system faces unique challenges: limited technological infrastructure, unstable power supply, restricted access to digital resources, and a lack of structured professional development opportunities. These barriers shape how teachers acquire and apply knowledge across the TPACK domains, creating distinct conditions that differ significantly from those in high-resource educational environments.

Existing research on TPACK has been heavily concentrated in developed countries such as the United States, Turkey, and Australia, leaving a substantial gap in understanding how this framework operates in low-resource settings. There is limited empirical evidence on the specific challenges faced by Liberian educators, the extent of their TPACK competencies, and how these competencies influence their professional performance. Furthermore, little is known about how the TPACK model can be adapted to fit the contextual realities of Liberian higher education, where institutions operate with limited funding and technical support.

This study addresses these gaps by examining the link between TPACK and teacher performance in three public universities in Liberia. It explores the levels of TPACK proficiency among educators, assesses their teaching effectiveness across planning, instruction, and assessment domains, and identifies the barriers and opportunities associated with technology integration. By generating localized evidence, the research aims to inform educational policy, guide the design of teacher training programs, and provide a foundation for future studies in similar

resource-constrained contexts. The findings will also contribute to the broader body of knowledge on educational technology, offering insights into how theoretical frameworks can be adapted and applied in diverse educational environments.

OBJECTIVES OF THE STUDY

The primary goal of this research is to explore the relationship between teachers' TPACK competencies and their professional performance in selected public universities in Liberia. Specifically, the study seeks to achieve the following objectives:

1. Assess the level of TPACK proficiency among teachers across the seven core domains: Content Knowledge, Pedagogical Knowledge, Technological Knowledge, Pedagogical Content Knowledge, Technological Content Knowledge, Technological Pedagogical Knowledge, and integrated TPACK.
2. Determine the level of teacher performance as measured by key indicators: instructional planning, classroom instruction, and student assessment practices.
3. Examine the significant relationship between the various TPACK domains and overall teaching performance, testing the hypothesis that no meaningful association exists between these variables.
4. Explore teachers' perceptions of their own TPACK competencies and how these shape their approaches to technology integration in teaching and learning.
5. Identify the practical challenges encountered by educators when applying TPACK principles in their daily instructional practices, particularly within the constraints of Liberia's educational context.
6. Develop evidence-based recommendations for policymakers, university administrators, and educators to enhance TPACK competencies and improve teaching quality, as well as propose a



framework for targeted professional development and resource allocation.

The study also aims to provide a reference for future research, offering empirical data and methodological guidance for investigations into TPACK and educational performance in developing nations.

METHODOLOGY

Research Design. This research utilizes a sequential explanatory mixed-methods design, combining quantitative and qualitative approaches to ensure comprehensive data collection and analysis. The design unfolds in two distinct phases:

Quantitative Phase: A non-experimental correlational survey design is used as the primary method. This phase involves the administration of structured questionnaires to measure TPACK competencies and teaching performance, enabling statistical analysis to determine the strength and direction of relationships between variables.

Qualitative Phase: Following the quantitative analysis, a thematic design is employed using semi-structured interviews. This phase serves to explain and contextualize the statistical findings, exploring the experiences, perceptions, and challenges of teachers in greater depth.

The integration of both phases ensures that the study benefits from the generalizability of quantitative data and the contextual richness of qualitative insights.

Population, Sample, and Sampling Technique. The target population includes all full-time and part-time teaching faculty at the three selected public universities in Liberia, who were actively engaged in instruction during the 2025/2026 academic year.

Quantitative Sample: Stratified random sampling is used to ensure proportional representation across institutions and academic disciplines. A total of 250 respondents were initially selected; however, 5 withdrew from the study, resulting in a final sample of 245 participants. This sample size is statistically sufficient to support the intended analyses, including correlation and regression modeling.

Qualitative Sample: Purposive maximum variation sampling is applied to select 10–15 participants from the survey respondents. Selection is based on their survey results, including those with high TPACK scores but low performance outcomes, and vice versa, to capture diverse experiences and perspectives.

Research Instrument. The primary instrument is a structured survey questionnaire designed to measure both TPACK and teacher performance. The TPACK section includes items that assess proficiency across the seven core domains, while the performance section evaluates effectiveness in planning, instruction, and assessment.

Validity: Construct validity is established through expert review and statistical analysis, with t-tests used to confirm that the instrument accurately measures the intended constructs.

Reliability: Internal consistency is tested using Cronbach's alpha coefficient, with a threshold value of 0.70 or higher indicating acceptable reliability.

For the qualitative phase, an interview guide is developed to explore topics such as barriers to technology integration, adaptive strategies, and perceptions of training and support.

DATA GATHERING PROCEDURE

Data collection proceeds in a systematic, ethical manner:



1. Permission and Preparation: Formal approval is obtained from university administrations, and participants are provided with informed consent forms outlining the purpose, scope, and ethical safeguards of the study.

2. Quantitative Data Collection: Questionnaires are distributed either in person or electronically via Google Forms. Completed responses are collected, organized, and prepared for statistical analysis.

3. Qualitative Data Collection: Selected participants are invited for interviews, which are conducted at a time and location of their convenience. Interviews are recorded with consent, transcribed verbatim, and analyzed thematically.

4. Ethical Considerations: Confidentiality, anonymity, and voluntary participation are strictly maintained throughout the process.

STATISTICAL TREATMENT OF DATA

Quantitative data are analyzed using descriptive and inferential statistical techniques with the support of SPSS Version 27 software:

Descriptive Statistics: Frequency distributions, percentages, means, and standard deviations are used to summarize demographic characteristics, TPACK levels, and performance outcomes.

Inferential Statistics: Pearson's correlation coefficient measures the relationship between TPACK domains and teacher performance. Multiple regression analysis identifies which TPACK components significantly predict teaching effectiveness. Independent samples t-tests and ANOVA are also used to examine differences across demographic and institutional groups, with a significance level set at 0.05.

Qualitative data are analyzed using thematic analysis, where recurring patterns and themes are

identified and linked to the quantitative findings to provide a holistic interpretation of results.

RESULTS AND DISCUSSION

1. Level of TPACK Proficiency

Analysis of survey data reveals that teachers exhibit varying levels of proficiency across the seven TPACK domains:

Strong Competencies: High mean scores are recorded for Content Knowledge (CK) and Pedagogical Knowledge (PK), indicating that educators possess strong subject-matter expertise and a solid understanding of general teaching principles. This aligns with existing literature, which identifies these domains as foundational to effective instruction.

Moderate Competencies: Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), and Technological Content Knowledge (TCK) show moderate levels of proficiency. Teachers demonstrate the ability to adapt content for diverse learners but face challenges in effectively integrating technology into these processes.

Limited Competencies: Technological Knowledge (TK) and integrated TPACK show the lowest levels of proficiency. Most respondents report basic familiarity with common digital tools but lack advanced skills and the ability to combine technology, pedagogy, and content cohesively and effectively. These findings are consistent with studies noting that limited access to resources and training are key barriers to technological competence in developing countries.

2. Level of Teacher Performance

Assessment of teaching performance indicates that educators generally perform well in instructional planning and classroom



management, areas closely linked to their strong content and pedagogical knowledge. However, performance in technology-enhanced instruction and digital assessment is relatively lower. Teachers rely heavily on traditional teaching methods, and the use of technology is mostly limited to basic tools such as word processors or presentation software. This pattern reflects the gap between existing competencies and the demands of modern educational practice, particularly in contexts where resources are limited.

3. Relationship Between TPACK and Teacher Performance

Statistical analysis confirms a significant positive relationship between overall TPACK proficiency and teacher performance. Higher levels of competence across all domains are associated with better teaching outcomes, with integrated TPACK and PCK emerging as the most significant predictors of effectiveness. These results support the theoretical framework of the study, demonstrating that the ability to combine knowledge across domains is more critical than proficiency in individual areas alone. The findings also highlight that while content and pedagogical knowledge are essential, technological competencies are necessary to enhance and modernize teaching practices.

4. Teachers' Perceptions and Challenges

Qualitative data provide deeper insights into these findings:

Perceptions: Teachers recognize the importance of technology in education and express a desire to improve their skills. However, many feel that their current competencies are insufficient to meet modern educational demands, and they often view technology as a supplementary tool rather than an integral part of instruction.

Challenges: The most frequently cited barriers include unstable electricity supply, limited

access to computers and internet connectivity, high costs of digital resources, and a lack of structured training programs. Teachers also note that institutional support and incentives for technology integration are inadequate, further limiting their ability to apply TPACK principles effectively.

Adaptive Strategies: Despite these challenges, educators have developed innovative approaches, such as sharing limited resources, using low-tech alternatives, and adapting teaching methods to suit available tools. These strategies demonstrate resilience and the ability to apply TPACK principles within contextual constraints.

Synthesis of Findings.

The results collectively confirm that TPACK is a critical determinant of teaching performance in Liberian public universities. While teachers possess strong foundational knowledge, technological limitations and contextual barriers hinder their ability to fully leverage the benefits of technology-enhanced instruction. The findings also highlight that professional development and resource allocation must be contextually relevant, addressing the specific challenges and needs of educators in low-resource settings.

CONCLUSIONS

Based on the findings of the study, the following conclusions are drawn:

1. *TPACK Proficiency:* Teachers in the selected public universities demonstrate strong competence in Content Knowledge and Pedagogical Knowledge, but their proficiency in Technological Knowledge and integrated TPACK remains limited. This imbalance reflects the contextual realities of limited resources and training opportunities.

2. *Teaching Performance:* Educators perform effectively in traditional instructional areas, but limited technological competencies constrain performance. The ability to integrate technology



into teaching and learning is a key factor that distinguishes effective instruction from traditional practice.

3. *Significant Relationship*: There is a statistically significant positive relationship between TPACK competencies and teacher performance. The more proficient teachers are across the TPACK domains, the higher their level of teaching effectiveness, confirming the importance of the framework as a measure of educational competence.

4. *Contextual Barriers*: Challenges such as inadequate infrastructure, limited resources, and insufficient training are the primary factors limiting the application of TPACK principles. These barriers are systemic and require coordinated interventions from institutions and policymakers.

5. *Adaptive Capacities*: Despite constraints, teachers exhibit adaptive capabilities and a willingness to improve their competencies, indicating that targeted support and resources can lead to meaningful improvements in teaching quality.

Overall, the study concludes that TPACK is a relevant and valuable framework for understanding and improving teaching performance in Liberian higher education. While contextual challenges persist, the findings demonstrate that investing in TPACK development can yield significant benefits for educational quality and student learning outcomes.

RECOMMENDATIONS

Based on the conclusions of the study, the following recommendations are proposed for key stakeholders:

For Policymakers

1. Develop national policies that prioritize the integration of technology in higher education, including provisions for infrastructure

development, resource allocation, and teacher training.

2. Design contextually relevant standards and guidelines for TPACK competencies, aligned with the realities and needs of the Liberian educational system.

3. Allocate funding and resources to support the procurement and maintenance of educational technology, as well as the development of local digital learning resources.

For University Administrators

1. Establish structured professional development programs that focus on enhancing TPACK competencies, with special emphasis on Technological Knowledge and integrated application of skills. These programs should be practical, ongoing, and adapted to available resources.

2. Improve institutional support systems, including the provision of reliable power supply, internet connectivity, and access to digital tools and learning materials.

3. Create incentives and recognition schemes to encourage teachers to adopt and innovate technology-enhanced teaching practices.

4. Foster collaborative learning communities among faculty members, enabling the sharing of knowledge, resources, and adaptive strategies for effective technology integration.

For Teachers

1. Take proactive steps to improve TPACK competencies through self-directed learning, participation in training programs, and collaboration with peers.

2. Adopt a flexible and adaptive approach to instruction, leveraging available resources and technologies to enhance learning outcomes, even in constrained environments.



3. Actively engage in curriculum design and development to ensure that teaching practices align with modern educational standards and technological advancements.

For Future Researchers

1. Conduct similar studies in private universities and other educational levels to provide a broader understanding of TPACK application across the Liberian education system.
2. Explore the impact of specific interventions, such as training programs or resource provision, on TPACK competencies and teaching performance.
3. Investigate the role of additional factors, such as institutional culture and leadership support, in shaping the relationship between TPACK and educational outcomes.

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