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Reclaiming Numeracy: Evaluating the Impact of the Culturo -Techno-Contextual Approach (CTCA) on Mathematical Perception in Sierra Leonean Higher Education

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ABSTRACT

Negative perception is a significant barrier to mathematical proficiency among tertiary students in West Africa. This study evaluates the impact of the Culturo-Techno-Contextual Approach (CTCA) on the cognitive and affective dispositions of 376 first-year students at the University of Makeni (UNIMAK), Sierra Leone. Findings from a quasi-experimental analysis demonstrate that CTCA significantly enhances student confidence, participation, and conceptual clarity. The study concludes that by centering instruction on the "Culturo-Techno" axis, educators can effectively dismantle "math anxiety" and improve academic performance.

Keywords: CTCA, student perception, STEM education, culturally responsive pedagogy, math anxiety, ICT in education, Sierra Leone, pedagogical innovation, self-efficacy, learner engagement.

INTRODUCTION

Despite the Sierra Leonean government's **Radical Inclusion Policy (2021)**, many students enter university with deep-seated negative perceptions of mathematics, viewing it as an abstract and alien discipline. This disconnect is often a byproduct of instructional methods that ignore the learner's cultural background and technological reality. The **Culturo-Techno-Contextual Approach (CTCA)** was developed to bridge this gap by integrating indigenous knowledge systems with modern technological tools. This paper evaluates the specific extent to which this approach enhances student perception. The novelty of this research lies in its specific application of the 'Culturo-Techno' axis within the unique socio-cultural landscape of Sierra Leone. While general pedagogical theories exist, this study provides a localized empirical model that transforms the 'Radical Inclusion Policy' from a theoretical framework into a practical classroom reality. By doing so, it offers a first-of-its-kind blueprint for dismantling mathematical barriers in the region's higher education institutions.

Theoretical Framework

This study is underpinned by **Self-Efficacy Theory (Bandura, 1997)** and **Situated Learning Theory (Lave & Wenger, 1991)**. These theories suggest that learning is most effective when students feel capable (efficacy) and when the knowledge is grounded in authentic, relatable environments. CTCA operationalizes these theories by utilizing local Sierra Leonean contexts and digital affordances to make mathematics "visible" and attainable.

METHODOLOGY

Using a mixed-methods approach, 376 students were exposed to CTCA-based instruction. Data were gathered through structured questionnaires measuring perception levels across three domains: **Engagement**, **Confidence**, and **Conceptual Understanding**. Inferential analysis was conducted using the independent-samples t-test to measure the significance of the shift in perception.

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DISCUSSION OF FINDINGS: THE "CULTURO-TECHNO" IMPACT

The results provide empirical evidence that CTCA significantly enhances student perception ($t(373.815) = 40.807$, $p < 0.05$).

Enhancing Affective Disposition and Confidence

The "Culturo" component of CTCA leverages local traditions and community knowledge to explain mathematical concepts. Findings indicate that this reduces the "threat" of mathematics, leading to higher mean scores in student confidence. When students see their own culture reflected in the logic of the curriculum, their intrinsic motivation increases, supporting the tenets of Self-Determination Theory. To address the specific shift in mathematical perception, the study utilized local Sierra Leonean traditions and indigenous logic to explain abstract numeracy concepts. This 'Culturo' intervention fundamentally altered how students perceived the subject—moving from a view of mathematics as a 'threat' or an 'alien discipline' to perceiving it as a familiar, community-rooted tool. The significant increase in confidence scores ($t = 40.807$) serves as empirical evidence of this perceptual shift from anxiety to self-efficacy.

Technological Affordances and Participation

The "Techno" aspect addresses the digital realities of contemporary learners. Integrating technological tools—ranging from mobile devices to interactive software—promotes active participation and transforms students from passive recipients into active discoverers of knowledge. The study found that this technological integration was a primary driver for the "Perception Level" increase observed in the experimental group.

Contextual Relevance and Conceptual Clarity

By situating abstract problems within the "Contextual" realities of Sierra Leone—such as local trade, architecture, or agriculture—CTCA enhances conceptual clarity. Students reported that mathematics felt "less abstract" and "more Relatable," leading to better retention and performance. Mathematical perception was further reclaimed by situating abstract problems within local trade, architecture, and agriculture. Qualitative feedback from students indicated that this contextualization caused mathematics to be perceived as 'less abstract' and 'more relatable'. This confirms that when the 'Contextual' reality of the learner is prioritized, their cognitive perception of numeracy evolves from a passive struggle to active, meaningful engagement.

CONCLUSION AND RECOMMENDATIONS

The Culturo-Techno-Contextual Approach (CTCA) is more than an instructional strategy; it is a tool for educational equity. By significantly improving students' perceptions, CTCA provides a scalable model for improving STEM education in Sierra Leone.

- **Institutional Adoption:** UNIMAK and similar institutions should integrate CTCA into their teacher-training curricula to ensure that the next generation of educators is equipped with this novel, culturally-responsive pedagogical toolkit.
- **Policy Integration:** The Ministry of Technical and Higher Education should endorse context-driven pedagogies to fulfill the promise of the Radical Inclusion Policy.

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