RIPPLE FAILURE EFFECTS OF MATHEMATICS ON ELECTRICAL AND ELECTRONIC ENGINEERING COURSES IN GHANAIAN TECHNICAL UNIVERSITIES

DISSERTATION

Submitted in partial fulfillment of the requirements for the degree of Doctorate in Technology and Vocational Education

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DECLARATION

I hereby certify that the dissertation, "**Ripple Failure Effects of Mathematics on Electrical and Electronic Engineering Courses in Ghanaian Technical Universities**", and all of its contents are entirely my work. I do not plagiarize or quote in ways that are not under the scientific ethics prevailing in the scientific community. For this statement, I am ready to bear the risk/sanction if in the future it is found that there is a violation of scientific ethics or there are claims from other parties regarding the authenticity of my work.

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DEDICATION

To my family and my children

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RIPPLE FAILURE EFFECTS OF MATHEMATICS ON ELECTRICAL AND ELECTRONIC ENGINEERING COURSES IN GHANAIAN TECHNICAL UNIVERSITIES

ABSTRACT

In the 21st century, many countries, including Ghana, face the challenge of keeping pace with rapid technological advancements, which have increased the associated demand for skilled technical and vocational education. The country's ten public technical universities are leading this effort in many areas, including electrical and electronic engineering programs, which have seen significant enrollment growth over the last decade due to the introduction of the free high school education and the Competency-Based Training approach. However, the success of these programs relies on students' understanding of engineering mathematics, and a significant gap in mathematics proficiency is undermining their ability to succeed. This gap poses a critical challenge, affecting students' overall performance and competency in engineering courses. Addressing this deficiency in mathematics education is essential for improving student outcomes and ensuring the effectiveness of Ghana's technical and vocational education system. This study therefore aimed to evaluate the complex relationship between mathematics failure and achievements in electrical and electronic engineering. The research examined the theoretical foundation, student performance, and practical application of mathematical ideas in electrical engineering using curriculum documents, mathematics achievement test, and student academic records The study sourced data from four technical universities in Ghana, through purposive cluster sampling, involving 488 Higher National Diploma students who had completed specific topics in engineering mathematics. This study employed quantitative methods including Covariance-Based Structural Equation Modeling, Bayesian Multiple Regression, Receiver Operating Characteristics Curve, and Dependency Graph Analyses to explore the complex relationship between mathematics failure and achievements in electrical and electronic engineering education. The analysis revealed a significant negative correlation of -0.72 between mathematics failure and academic achievements, mediated by cognitive failure. This correlation was found to be influenced by students' early mathematical foundation. Specifically, the study estimated the effects of failure in both general mathematics and specific mathematics domains on students' achievements. Furthermore, the electrical and electronic engineering courses were classified according to their levels of susceptibility to mathematics failure effects. The study identified distinct paths of ripple effects that mathematics failure had on the engineering courses. Based on these findings, it was recommended that policy makers, instructors and learners must give attention to learning paths consisting of courses that need the concepts of specific aspects of mathematics, and put in more efforts in these areas in other to achieve successs.

Key Words: *Ripple Failure Effect, EEE, Cognitive Failure, Mathematics Failure, Achievement*

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