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Structural Equation Modeling (SEM) of the Relationship between Quantitative Self-Efficacy and Quantitative Reasoning in Economics among Senior Secondary School Students in Nsukka Education Zone

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Abstract

This study investigated the structural equation model of the relationship between quantitative self-efficacy and quantitative reasoning in Economics among senior secondary school students in Nsukka Education Zone. A cross-sectional correlational research design employing Structural Equation Modeling (SEM) was adopted. The population comprised 3422 SS2 Economics students, while a sample of 270 students was selected using a multi-stage sampling technique. The study was guided by three research questions and two null hypotheses. Two instruments were used: The Quantitative Self-Efficacy Questionnaire (20 items) and the Quantitative Reasoning Test in Economics (45 items). The instruments were validated by three experts, comprising one expert in Economics Education and two experts in Measurement and Evaluation, to ensure content validity, with reliability coefficients of 0.79 and 0.85, respectively, estimated using the psych package in RStudio. Data were analyzed using Structural Equation Modeling (SEM) with the lavaan package in RStudio, at a 0.05 significance level. The results revealed that the overall structural model satisfied conventional global fit criteria (CFI = 1.000, TLI = 1.000, RMSEA = .000, SRMR = .021, χ^2 (8) = 2.813, p = .946). However, the measurement model demonstrated notable weaknesses. Specifically, two indicators significantly measured quantitative self-efficacy, whereas one indicator was not significant. In contrast, none of the indicators of quantitative reasoning was statistically significant, indicating inadequate measurement of the construct. The structural model revealed that quantitative self-efficacy did not significantly predict quantitative reasoning (β = −.990, p = .995). Given the inadequate measurement of the quantitative reasoning construct, confidence in the structural model results was limited; therefore, the structural relationship should be interpreted with caution. Based on the findings, it was concluded that although the overall model satisfied conventional global fit criteria, the inadequate measurement of the quantitative reasoning construct limited confidence in the structural model results. It was recommended that future studies should refine and validate the quantitative reasoning instrument through confirmatory factor analysis before estimating structural models and examine additional variables, such as mathematics achievement, prior Economics knowledge, logical reasoning ability, and classroom instructional quality, that may explain students' quantitative reasoning.

Keywords: Economics Education, Nsukka Education Zone, Enugu State, quantitative reasoning, quantitative self-efficacy, Senior Secondary Two (SS2) students.

Introduction

Economics is a core subject at the senior secondary school level that equips learners with the knowledge and skills required to understand how individuals, firms, and governments make decisions regarding the allocation of scarce resources. The subject requires students to interpret economic data, analyse relationships among economic variables, solve quantitative problems, and make informed decisions based on numerical and graphical information. Consequently, effective learning of Economics extends beyond the acquisition of theoretical knowledge to include the ability to apply quantitative reasoning in analysing real-life economic situations. These competencies are essential for academic success and for preparing students to participate effectively in an increasingly data-driven

society (Organisation for Economic Co-operation and Development [OECD], 2023; Zlatkin-Troitschanskaia et al., 2023). Despite the importance of quantitative competencies in Economics, many senior secondary school students continue to experience considerable difficulty in applying quantitative reasoning when solving economic problems. Reports of students' performance in public examinations consistently indicate weaknesses in interpreting graphs, analysing statistical information, computing elasticity, and solving quantitative Economics questions (West African Examinations Council [WAEC], 2023). Similar concerns have been reported internationally, where students continue to demonstrate inadequate competency in quantitative literacy and numeracy-related tasks despite curriculum reforms aimed at improving analytical thinking (OECD, 2023).

These persistent challenges suggest that factors beyond subject knowledge may influence students' ability to reason quantitatively. Quantitative reasoning refers to the ability to interpret, analyse, evaluate, and apply numerical information to solve problems and make logical decisions. Within Economics education, quantitative reasoning enables students to analyse relationships among economic variables, interpret tables and graphs, evaluate statistical information, and apply mathematical concepts to explain economic phenomena. Contemporary educational research recognises quantitative reasoning as a higher-order cognitive competency that integrates mathematical thinking, logical analysis, interpretation, and evidence-based decision-making (Schmidt et al., 2022; Zlatkin-Troitschanskaia et al., 2023). Nevertheless, students' achievement in quantitative aspects of Economics remains unsatisfactory, particularly in areas requiring graph interpretation, quantitative analysis, and numerical problem-solving (WAEC, 2023). This persistent underachievement suggests that cognitive ability alone may not sufficiently explain students' performance, thereby highlighting the importance of examining psychological variables that may influence quantitative reasoning. One psychological factor that has attracted considerable attention in educational psychology is self-efficacy. Self-efficacy is a central construct of Bandura's (1997) Social Cognitive Theory and refers to individuals' beliefs in their capability to organise and execute the actions required to achieve specific goals. According to the theory, self-efficacy influences learners' motivation, persistence, effort, resilience, and willingness to engage in challenging learning tasks. Students who possess strong beliefs in their capabilities are more likely to approach difficult tasks confidently, persist despite obstacles, and employ effective learning strategies, whereas students with low self-efficacy often avoid challenging activities and exhibit reduced persistence (Bandura, 1997; Schunk & DiBenedetto, 2024).

Within the context of Economics education, quantitative self-efficacy refers to students' confidence in their ability to perform quantitative and analytical tasks, including interpreting graphs, solving numerical problems, analysing statistical data, calculating economic indices, and applying mathematical procedures to economic situations. Previous studies have consistently reported positive associations between academic self-efficacy and learning outcomes such as motivation, engagement, persistence, and academic achievement (Honicke & Broadbent, 2023; Schunk & DiBenedetto, 2024). However, evidence regarding the relationship between self-efficacy and quantitative reasoning remains inconclusive. While some studies suggest that students with high self-efficacy demonstrate stronger reasoning abilities, others indicate that confidence alone may not translate into improved reasoning performance when cognitive competence, prior knowledge, or instructional quality is inadequate (Honicke et al., 2023). The inconsistency in previous findings may partly be attributed to methodological limitations. Many earlier studies investigating the relationship between self-efficacy and academic performance relied primarily on conventional statistical techniques such as correlation and multiple regression analyses.

Although these methods are useful for examining relationships among observed variables, they assume that variables are measured without error and do not explicitly account for the latent nature of psychological constructs. Consequently, they provide limited information regarding the adequacy of the measurement model and the structural relationships among latent variables. Structural Equation Modeling (SEM) provides a more comprehensive analytical framework for examining relationships among latent constructs because it simultaneously evaluates the measurement properties of the constructs and the structural relationships among them while accounting for measurement error (Hair et al., 2022; Kline, 2023). By integrating confirmatory factor analysis with path analysis, SEM enables researchers to determine whether observed indicators adequately measure their respective latent constructs before interpreting structural relationships. This feature makes SEM particularly appropriate for investigating the relationship between quantitative self-efficacy and quantitative reasoning, both of which are latent constructs measured through multiple observed

indicators. Although several studies have examined self-efficacy in relation to mathematics achievement and general academic performance, empirical evidence specifically addressing the relationship between quantitative self-efficacy and quantitative reasoning in Economics among senior secondary school students remains limited, particularly within the Nigerian educational context. Furthermore, few studies have employed Structural Equation Modeling to investigate this relationship while simultaneously evaluating the validity of the measurement model. This methodological and contextual gap underscores the need for further investigation. Against this background, the present study examined the relationship between quantitative self-efficacy and quantitative reasoning in Economics among Senior Secondary School II students in Nsukka Education Zone, Enugu State, Nigeria, using Structural Equation Modeling. The study sought to determine whether the observed indicators adequately measured the latent constructs and whether quantitative self-efficacy significantly predicted quantitative reasoning after accounting for measurement error.

Theoretical Framework

This study is anchored on Albert Bandura's Social Cognitive Theory (1997), particularly the concept of self-efficacy. The theory explains human behaviour as the dynamic interaction among personal factors, behaviour, and environmental influences. Through reciprocal determinism, individuals both influence and are influenced by their beliefs, behaviours, and learning environments. A central construct of the theory is self-efficacy, defined as an individual's belief in their capability to organize and execute actions required to accomplish specific tasks. Bandura (1997) posits that self-efficacy influences individuals' choice of activities, effort, persistence, and resilience when faced with challenges. A major strength of the theory is its recognition that learners actively regulate their learning through cognitive beliefs and behaviours.

However, it has been criticised for placing greater emphasis on individual beliefs than on contextual factors such as instructional quality, school resources, and social conditions. In this study, quantitative self-efficacy refers to students' confidence in performing numerical and analytical tasks, such as interpreting graphs, solving quantitative problems, and analysing economic data. In contrast, quantitative reasoning refers to their ability to interpret, evaluate, and apply numerical information to solve problems and make logical decisions in Economics. Although Social Cognitive Theory explains beliefs rather than reasoning ability itself, it provides a theoretical basis for understanding how quantitative self-efficacy may influence quantitative reasoning. Students with higher quantitative self-efficacy are more likely to engage confidently in quantitative tasks, exert greater effort, persist when faced with challenges, and apply effective problem-solving strategies, thereby enhancing quantitative reasoning. Conversely, students with low quantitative self-efficacy may avoid challenging tasks and demonstrate reduced persistence, limiting opportunities to develop quantitative reasoning.

Social Cognitive Theory was adopted because it provides an appropriate framework for explaining the relationship between students' beliefs about their quantitative abilities and their quantitative reasoning. Although Expectancy-Value Theory and Self-Determination Theory explain academic motivation, Social Cognitive Theory is more appropriate because it places self-efficacy at the centre of learning behaviour. Its emphasis on relationships among latent psychological constructs also provides theoretical support for applying Structural Equation Modeling (SEM) to examine the relationship between quantitative self-efficacy and quantitative reasoning.

Conceptual Framework

The conceptual framework for this study illustrates the hypothesized relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students studying Economics. The framework proposes that quantitative self-efficacy influences students' quantitative reasoning by shaping their confidence, persistence, and engagement in quantitative tasks. Although the framework focuses on quantitative self-efficacy as the primary predictor of quantitative reasoning, it is acknowledged that other factors, including prior mathematics achievement, Economics achievement, instructional quality, motivation, socioeconomic status, and logical reasoning ability, may also influence students' quantitative reasoning performance. However, these variables are beyond the scope of the present study, which focuses specifically on the contribution of quantitative self-efficacy. The relationship is examined using Structural Equation Modeling (SEM), which comprises the measurement and structural models.

The measurement model specifies how the latent constructs are represented by their observed indicators, with quantitative self-efficacy and quantitative reasoning measured through multiple observed indicators. The structural model examines the hypothesized relationship between these latent

constructs by estimating the effect of quantitative self-efficacy on quantitative reasoning.

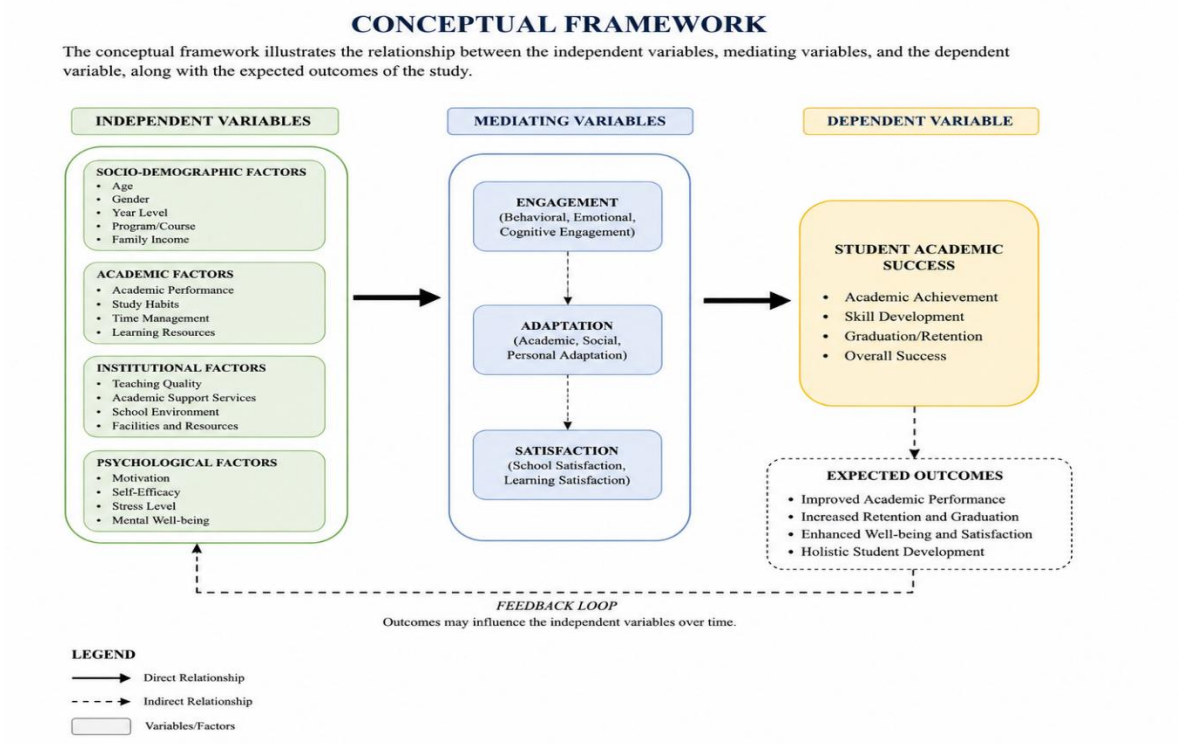

Figure 1

Statement of the Problem

Despite the importance of Economics in developing students' analytical and quantitative competencies, many senior secondary school students continue to experience difficulties in interpreting numerical data, analysing graphs, and applying logical reasoning in Economics examinations (WAEC Chief Examiners' Report, 2023). These challenges may adversely affect students' achievement in Economics, limit their preparedness for higher education programmes requiring analytical skills, and reduce their ability to develop the financial literacy competencies needed for effective economic decision-making. Although several factors may influence students' quantitative reasoning, the role of psychological factors, particularly quantitative self-efficacy, remains insufficiently understood within Economics education. Quantitative self-efficacy refers to students' beliefs about their ability to successfully perform numerical and analytical tasks. While self-efficacy has been associated with students' engagement, persistence, and academic performance, limited empirical evidence exists regarding its relationship with quantitative reasoning among senior secondary school Economics students. The existing gap may be viewed from empirical, methodological, contextual, and theoretical perspectives. Empirically, previous studies have focused mainly on self-efficacy in relation to general academic achievement or mathematics performance, with limited attention to quantitative reasoning in Economics. Methodologically, many studies have relied on conventional statistical techniques that do not adequately account for measurement error or the latent nature of psychological and cognitive constructs. Consequently, few studies have applied Structural Equation Modeling (SEM) to examine both the measurement properties of quantitative self-efficacy and quantitative reasoning, as well as the structural relationship between these constructs. Contextually, limited evidence exists regarding this relationship among senior secondary school Economics students in Nigerian educational settings, particularly in Nsukka Education Zone.

Theoretically, although Social Cognitive Theory explains the influence of self-efficacy on learning behaviour, further investigation is needed to understand how students' beliefs about their quantitative abilities translate into quantitative reasoning performance. Therefore, it remains unclear whether students' confidence in their quantitative abilities predicts their quantitative reasoning performance in Economics within the secondary school context. Addressing this gap may provide

useful evidence for developing instructional strategies that strengthen students' engagement with quantitative tasks and improve their reasoning abilities. Hence, this study seeks to examine the measurement and structural relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students in Nsukka Education Zone, Enugu State, using Structural Equation Modeling (SEM).

Purpose of the Study

The main purpose of this study was to examine the structural relationship between quantitative self-efficacy and quantitative reasoning in Economics among senior secondary school students in Nsukka Education Zone through the application of Structural Equation Modeling (SEM) relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students in Nsukka Education Zone using Structural Equation Modeling (SEM). Specifically, the study seeks to:

1. Determine the extent to which the observed indicators significantly measure the latent constructs of quantitative self-efficacy and quantitative reasoning among senior secondary school students.
2. Determine the extent to which the proposed Structural Equation Model fits the observed data in explaining the relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students.
3. Determine the direct structural effect of quantitative self-efficacy on quantitative reasoning among senior secondary school students.

Research Questions

The following research questions guided the study:

1. To what extent do the observed indicators significantly measure the latent constructs of quantitative self-efficacy and quantitative reasoning among senior secondary school students?
2. To what extent does the proposed Structural Equation Model fit the observed data in explaining the relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students?
3. What is the direct structural effect of quantitative self-efficacy on quantitative reasoning among senior secondary school students?

Hypotheses

The following null hypotheses were formulated and tested at the 0.05 level of significance:

1. H_{01}: The proposed Structural Equation Model does not adequately fit the observed data in explaining the relationship between quantitative self-efficacy and quantitative reasoning.
2. H_{02}: There is no significant direct structural effect of quantitative self-efficacy on quantitative reasoning

Methodology

Research Design

This study adopted a cross-sectional explanatory correlational research design employing Structural Equation Modeling (SEM). The design was appropriate because it enabled the researcher to examine the relationship between quantitative self-efficacy and quantitative reasoning among Senior Secondary School II (SS II) students without manipulating the variables. Structural Equation Modeling (SEM) was employed because it simultaneously estimates the measurement and structural models while accounting for measurement error, thereby providing a more robust evaluation of the hypothesized relationships among the latent constructs (Hair et al., 2022; Kline, 2023).

Area of the Study

The study was conducted in Nsukka Education Zone of Enugu State, Nigeria. The zone comprises the three Local Government Areas (LGAs) of Nsukka, Igbo-Etiti, and Uzo-Uwani. It has sixty-one (61) public secondary schools, comprising thirty-one (31) in Nsukka LGA, fifteen (15) in Igbo-Etiti LGA, and fifteen (15) in Uzo-Uwani LGA. The zone has a large population of students offering Economics, making it an appropriate setting for investigating quantitative self-efficacy and quantitative reasoning.

Population of the Study

The population of the study comprised 3,422 Senior Secondary School II (SS II) Economics students in public secondary schools in Nsukka Education Zone. This consisted of 2,378 students from Nsukka Local Government Area (LGA), 726 students from Igbo-Etiti LGA, and 318 students from Uzo-Uwani LGA (Planning, Research and Statistics [PRS] Department, Post Primary School Management Board [PPSMB], Nsukka, 2025).

Sample and Sampling Technique

A sample of 270 SS II Economics students was used for the study. The sample size was considered adequate for Structural Equation Modeling because it met the recommended sample requirements for relatively simple SEM models involving latent constructs (Hair et al., 2022; Kline, 2023). The sample was selected using a multi-stage sampling technique. In the first stage, the education

zone was stratified into the three LGAs. In the second stage, twelve (12) public secondary schools offering Economics were selected through simple random sampling by balloting, comprising six (6) schools from Nsukka LGA, three (3) from Igbo-Etiti LGA, and three (3) from Uzo-Uwani LGA. In the third stage, SS II Economics students were selected from the sampled schools using simple random sampling. The sample was proportionately distributed as follows: 188 students from Nsukka LGA, 58 from Igbo-Etiti LGA, and 24 from Uzo-Uwani LGA. Although the subgroup sizes were unequal, proportionate allocation was adopted to ensure that the sample reflected the population distribution across the three LGAs.

Instruments for Data Collection

Two instruments were used for data collection. The first was the Quantitative Self-Efficacy Questionnaire (QSEQ), comprising 20 five-point Likert-scale items designed to measure students' confidence in performing quantitative tasks in Economics, such as graph interpretation, numerical computation, quantitative analysis, and problem-solving. The second instrument was the Quantitative Reasoning Test in Economics (QRTE), consisting of 45 multiple-choice items scored dichotomously (1 for each correct response and 0 for each incorrect response). The instrument measured students' ability to interpret, analyse, and apply quantitative information in solving Economics problems. The QRTE was developed using a Table of Specification to ensure adequate coverage of the curriculum content and cognitive objectives.

Validation of the Instruments

The instruments were subjected to face and content validation by three experts, comprising two experts in Measurement and Evaluation and one expert in Economics Education, University of Nigeria, Nsukka, to establish their face and content validity. The experts assessed the relevance, clarity, and adequacy of the items, and their suggestions were incorporated into the final versions of the instruments.

Reliability of the Instruments

The reliability of the instruments was determined using the psych package in RStudio statistical software. The Quantitative Self-Efficacy Questionnaire (QSEQ) yielded a reliability coefficient of 0.79, while the Quantitative Reasoning Test in Economics (QRTE) yielded a reliability coefficient of 0.85. The schools used for the reliability study were not included in the main study.

Method of Data Collection

The researcher administered the instruments with the assistance of trained research assistants. The questionnaire and the test were administered and retrieved immediately after completion to ensure a high retrieval rate and minimize data loss.

Method of Data Analysis

Data were analyzed using the lavaan package in RStudio. Composite scores were computed for QSEQ, while QRTE scores were obtained by summing correct responses. Structural Equation Modeling (SEM) was conducted in two stages: evaluation of the measurement model to assess indicator–construct relationships, followed by estimation of the structural model to examine the relationship between quantitative self-efficacy and quantitative reasoning. Model fit was evaluated using χ^2, CFI, TLI, RMSEA, and SRMR based on recommended criteria (Hair et al., 2022; Kline, 2023). Standardized factor loadings and regression coefficients were examined, and statistical decisions were made at the 0.05 significance level.

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Results

Table 1: Extent to Which the Observed Indicators Measure the Latent Constructs of Quantitative Self-Efficacy and Quantitative Reasoning

Latent Construct	Indicator	Standardized Loading (β)	z-value	p-value	Decision
Quantitative Self-Efficacy (QSE)	L17	0.393	2.456	.014	Significant
	L18	0.317	2.221	.026	Significant
	L6	0.123	0.976	.329	Not Significant
Quantitative Reasoning (QR)	D3	-0.089	-0.006	.995	Not Significant
	D5	-0.093	-0.007	.995	Not Significant
	D10	-0.337	-0.007	.995	Not Significant

Table 1 presents the standardized factor loadings of the observed indicators measuring the latent constructs of quantitative self-efficacy and quantitative reasoning among senior secondary school students. Indicators with $p < .05$ were considered to provide significant evidence of adequately measuring their respective latent constructs. The results revealed that two of the three observed indicators of quantitative self-efficacy significantly measured the latent construct. Specifically, L17 (Std. $\beta = 0.393$, $z = 2.456$, $p = .014$) and L18 (Std. $\beta = 0.317$, $z = 2.221$, $p = .026$) had statistically significant factor loadings, indicating that they adequately represented quantitative self-efficacy. However, L6 (Std. $\beta = 0.123$, $z = 0.976$, $p = .329$) did not significantly measure the latent construct, suggesting that it contributed weakly to the measurement of quantitative self-efficacy. For quantitative reasoning, none of the three observed indicators significantly measured the latent construct. The standardized factor loadings for D3 (Std. $\beta = -0.089$, $z = -0.006$, $p = .995$), D5 (Std. $\beta = -0.093$, $z = -0.007$, $p = .995$), and D10 (Std. $\beta = -0.337$, $z = -0.007$, $p = .995$) were all statistically insignificant, indicating that these indicators did not adequately represent quantitative reasoning in the measurement model. Overall, the findings indicate that the observed indicators provided partial evidence for the adequate measurement of quantitative self-efficacy but did not provide sufficient evidence for the adequate measurement of quantitative reasoning. These findings suggest that the measurement model was stronger for quantitative self-efficacy than for quantitative reasoning and should therefore be considered when interpreting the subsequent structural model results.

Table 2: **Extent to Which the Proposed Structural Equation Model Fits the Observed Data**

Fit Index	Obtained Value	Recommended Criterion	Decision
Chi-square (χ^2)	2.813	Non-significant ($p > .05$)	Accepted
Degrees of Freedom (df)	8	—	—
p-value	.946	> .05	Accepted
Comparative Fit Index (CFI)	1.000	≥ .95	Accepted
Root Mean Square Error of Approximation (RMSEA)	0.000	≤ .06	Accepted
RMSEA 90% Confidence Interval	0.000–0.010	Narrow interval preferred	Accepted
Standardized Root Mean Square Residual (SRMR)	0.021	≤ .08	Accepted

Table 2 presents the goodness-of-fit indices of the proposed Structural Equation Model (SEM) developed to explain the relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students. The model fit was evaluated using the chi-square statistic (χ^2), degrees of freedom (df), Comparative Fit Index (CFI), Root Mean Square Error of Approximation (RMSEA), and Standardized Root Mean Square Residual (SRMR). The model produced a chi-square value of 2.813 with 8 degrees of freedom ($\chi^2 = 2.813$, df = 8, p = .946). The non-significant chi-square indicates that there was no statistically significant difference between the observed covariance matrix and the covariance matrix implied by the proposed model, suggesting that the model adequately reproduced the observed data. The Comparative Fit Index (CFI) of 1.000 exceeded the recommended minimum value of .95, indicating that the proposed model fitted the observed data substantially better than the baseline model. The Root Mean Square Error of Approximation (RMSEA) was 0.000, with a 90% confidence interval ranging from 0.000 to 0.010, indicating negligible approximation error and a precise estimate of model fit. Furthermore, the Standardized Root Mean Square Residual (SRMR) was 0.021, which is below the recommended maximum value of .08, indicating minimal discrepancy between the observed correlations and those reproduced by the model. Overall, the model demonstrated acceptable global fit based on the χ^2, CFI, RMSEA, and SRMR indices. However, the satisfactory global fit should be interpreted with caution because the quantitative reasoning construct and the quantitative self-efficacy construct exhibited weak measurement properties.

Hypothesis One (H_{01})

Based on the collective evidence provided by the goodness-of-fit indices presented in Table 2, the proposed Structural Equation Model demonstrated adequate overall fit to the observed data. Accordingly, the null hypothesis was rejected, indicating that the model adequately fitted the observed data.

Table 3: Direct Structural Effect of Quantitative Self-Efficacy on Quantitative Reasoning among Senior Secondary School Students

Predictor Variable	Outcome Variable	Estimate	Std. Error	Std. β	z-value	p-value	Decision
Quantitative Self-Efficacy	Quantitative Reasoning	-7.039	1071.188	-0.990	-0.007	.995	NS

Table 3 reports the structural relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students. The structural relationship was evaluated using the standardized path coefficient (Std. β), the z-value, and the probability (p) value. The results revealed a standardized path coefficient (Std. β) of −0.990, suggesting a negative direction of the relationship between quantitative self-efficacy and quantitative reasoning. However, the relationship was not statistically significant (z = −0.007, p = .995), since the probability value exceeded the 0.05 level of significance. This indicates that quantitative self-efficacy did not significantly predict quantitative reasoning among senior secondary school students. Overall, the findings indicate that there was a negative but non-significant structural relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students.

Hypothesis Two (H_{02})

Based on the goodness-of-fit indices, the proposed Structural Equation Model demonstrated acceptable global fit to the observed data. However, the measurement model exhibited weaknesses; therefore, the model fit should be interpreted with caution

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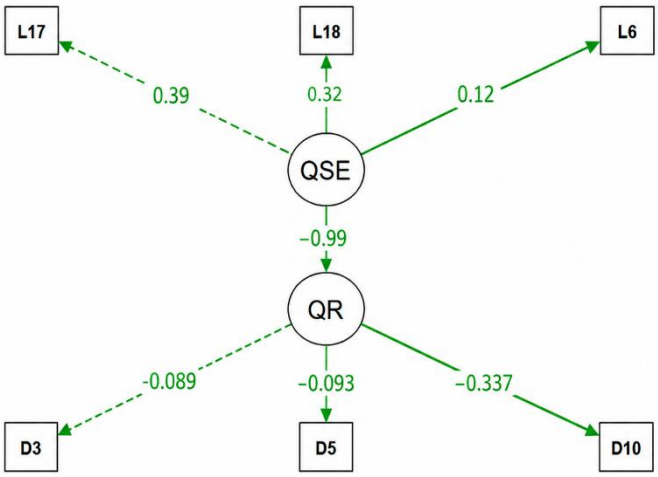
Estimated Structural Equation Model of Quantitative Self-Efficacy and Quantitative Reasoning



Note:

Figure 2

QSE = Quantitative Self-Efficacy; QR = Quantitative Reasoning. Values on the arrows represent standardized parameter estimates.

Discussion

The finding of Research Question One revealed that two of the three observed indicators significantly measured quantitative self-efficacy, whereas one indicator did not significantly contribute to the construct. Specifically, items L17 and L18 significantly measured quantitative self-efficacy, although their standardized factor loadings were relatively low, while item L6 was not statistically significant, suggesting that the quantitative self-efficacy construct may benefit from further refinement. The indicators of quantitative reasoning were all statistically non-significant with weak negative estimates, suggesting that the selected indicators did not adequately represent the construct. This finding agrees with Street, Malmberg, and Schukajlow (2024), who emphasized that mathematics self-efficacy is a multidimensional construct influenced by measurement approaches and contexts. Similarly, Nurlinda, Azis, and Nasution (2024) reported that self-efficacy and mathematical reasoning are related constructs, although their relationships may depend on learning conditions and assessment approaches. A possible reason for this finding is that students may have interpreted some items differently based on their academic experiences and exposure to quantitative tasks. Additionally, the weak measurement of quantitative reasoning may have resulted from inadequate representation of its multidimensional nature, including logical thinking, analytical ability, numerical interpretation, and problem-solving competence. Therefore, further refinement and validation of the quantitative reasoning indicators are necessary.

The finding of Research Question Two showed that the proposed structural equation model of quantitative self-efficacy and quantitative reasoning demonstrated excellent fit to the observed data. The model produced satisfactory fit indices, including a non-significant chi-square value, acceptable CFI, and low RMSEA and SRMR values. These findings indicate that the observed covariance structure was consistent with the hypothesized model. Although the Tucker-Lewis Index exceeded the recommended threshold, it was not interpreted because values above 1.00 are not considered

meaningful. This finding is consistent with Hair et al. (2022) and Kline (2023), who emphasized that SEM models should be evaluated using multiple fit indices rather than a single statistic. A possible reason for this finding is that the model adequately reproduced the covariance structure of the observed data despite the weak measurement properties of the quantitative reasoning construct. Therefore, the satisfactory global fit should be interpreted with caution because good model fit does not necessarily indicate adequate construct measurement. However, the excellent fit should be interpreted cautiously because the quantitative reasoning indicators did not significantly measure the latent construct. Thus, good model fit alone does not guarantee construct validity, and the weak measurement properties of quantitative reasoning limit confidence in the structural interpretation. The limited number of latent variables may also have contributed to model stability.

The finding of Research Question Three revealed that quantitative self-efficacy did not significantly predict quantitative reasoning among senior secondary school students in Nsukka Education Zone. The relationship between the constructs was negative but statistically non-significant, indicating that students' confidence in performing quantitative tasks did not significantly explain their reasoning ability within the model. This finding is supported by Landa, Berciano, and Marbán (2025), who reported that self-efficacy interacts with other factors in explaining mathematical problem-solving outcomes. Similarly, Nurlinda, Azis, and Nasution (2024) found that the relationship between self-efficacy and mathematical reasoning depends on learning conditions, instructional approaches, and measurement procedures. A possible reason for the non-significant relationship found in the present study is that quantitative reasoning may depend more on cognitive competence, prior mathematical knowledge, analytical skills, instructional quality, and learning experiences than on confidence alone. Some students may have high confidence without adequate reasoning skills, while others may demonstrate strong reasoning ability despite lower self-confidence. Furthermore, weak measurement properties of quantitative reasoning may have reduced the ability of the model to detect a significant relationship. The large negative coefficient with a non-significant p-value suggests possible estimation instability; therefore, the structural relationship should be interpreted with caution. The study examined the relationship between quantitative self-efficacy and quantitative reasoning among senior secondary school students in Nsukka Education Zone using Structural Equation Modeling (SEM). The findings indicate that although the proposed Structural Equation Model achieved satisfactory global fit, the weak measurement of the quantitative reasoning construct limits the confidence with which the structural relationship can be interpreted. Consequently, the non-significant relationship between quantitative self-efficacy and quantitative reasoning should be viewed in light of the limitations of the measurement model rather than as definitive evidence that no relationship exists. The findings provide partial support for Bandura's Social Cognitive Theory. While the theory emphasizes the role of self-efficacy in influencing cognitive performance, the present study was unable to provide strong empirical support for this proposition because the quantitative reasoning construct was not adequately measured. The study contributes to the growing application of Structural Equation Modeling in Economics education by demonstrating the importance of establishing sound measurement models before drawing substantive conclusions about structural relationships. It also underscores the need to strengthen the measurement of quantitative reasoning to support more reliable evidence for educational practice and future research.

Recommendations

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

1. Economics teachers should strengthen students' quantitative reasoning through problem-solving and quantitative learning activities.
2. Curriculum planners and assessment specialists should refine and validate the quantitative reasoning instrument before its use in structural models.
3. Teachers should promote both quantitative self-efficacy and quantitative reasoning, as confidence alone may not improve reasoning ability.
4. Future researchers should examine additional variables influencing quantitative reasoning and validate the measurement model before estimating structural relationships.

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