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Causal Modeling of Cognitive Load, Teachers' Support-Services in Preparing For Test and Examination Malpractice on Achievement in Mathematics in Akwa Ibom State, Nigeria

Nathan, Ndefreke Adolf[1], Utibe, Uduak James[2], Prof. John J. Agah[3]
Abasi, Andrew Umo[4] & John Olakunle Babayemi[5]
[1,2,4,5] *Department of Science Education, Akwa Ibom State University, Ikot Akpaden, Mkpat Enin, Akwa Ibom State, Nigeria*
[2]ORCID NO: 0000-0002-0654-4485
[3] *Department of Science Education, University of Nigeria, Nsukka, Enugu State, Nigeria*
E-mail: ndynathan@gmail.com, uduakutibe@aksu.edu.ng, john.agah@unn.edu.ng, andrewumoeka@gmail.com, babayemiolueole@gmail.com

ABSTRACT

The study was aimed at developing a causal model of cognitive load, teachers' support services in preparing for test and examination malpractice on achievement in mathematics in Akwa Ibom State, Nigeria. The study was guided by two null hypotheses. A correlational survey research design was adopted for the study. The population of the study comprised 60,821 Junior Secondary Two (JS2) students in public secondary schools in Akwa Ibom State in the 2024/2025 academic year. A sample of 936 JS2 students in public secondary schools drawn using a multi-stage sampling procedure participated in the study. Four instruments: Mathematics Achievement Test (MAT), Students' Cognitive Load questionnaire (SCLQ), Teachers' Support Services in Test Preparation Questionnaire (TSTPQ), and Examination Malpractice Questionnaire (EMQ), developed by the researchers, were used for data collection. Three experts in relevant fields face-validated the instruments. The instruments were further subjected to construct validation through factor analysis. The reliability of the instruments was established using an estimate of internal consistency after trial-testing. Data obtained from the MAT was analysed using the Kuder-Richardson formula 20, which yielded a reliability coefficient of 0.83. The reliability for TCLQ, TSTPQ, and EMQ was determined using the Cronbach Alpha method, and the reliability coefficients obtained were 0.92, 0.86, and 0.85, respectively. Data collected from the actual study were analysed using a single-stage Partial Least Squares–Structural Equation Modeling (PLS-SEM) through Warp PLS, computer-based software. The findings of the study, among others, revealed that the most parsimonious causal model retained cognitive load dimensions (intrinsic, extraneous, and germane), teachers' support services, and examination malpractice. Hence, it was recommended among others that schools should strengthen teachers-student interactions through structured mentorship, personalized instructional support, and guidance to improve students' mathematics achievement and reduce examination malpractice.

Keywords: *Causal-modeling, cognitive load, teachers' support-services, test, examination malpractice, achievement, mathematics*

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INTRODUCTION

Education has been an aspect of human life throughout history. It is a fundamental instrument that brings positive change in an individual and society. Education is an inalienable right of every person, as recognised in the Universal Declaration of Human Rights (1947) and the Universal Covenant of Economic, Social and Cultural Rights. Indeed, education is a cornerstone of economic growth, social development, and the principal means of improving the welfare of individuals (World Bank, World Development Report 2018).

Mathematics is indeed one of the most useful and fascinating subjects humans have created, and therefore, its importance in everyday life cannot be overstated. Agah *et al.* (2022) stated that life without mathematics is almost impossible and that it would be difficult to live a normal life in many parts of the world without mathematics. That is why mathematics is made a compulsory subject for all students at the primary and secondary school levels in Nigeria (Eugenia, 2020). The basic skills underlying all scientific and technological skills are the control of the tools of mathematics. Mathematics is seen as the language used to describe the problems arising in most branches of science and technology (Ogbu & Anyaegbu, 2021; Utibe *et al.,* 2023). Parents and guardians are usually given feedback on their children's activities in school in terms of examination results, which indicate students' academic performance.

Academic achievement is used in the school to refer to students' success in learning specified curriculum content as revealed by continuous assessment and examination. Academic achievement is a measure of the degree of success in performing specific tasks in a subject or area of study by students after a learning experience (National Centre for Education Statistics, 2020). Academic achievement is a major issue for teachers, students, parents and guardians, as well as other stakeholders in the education industry. This concern cuts across all school subjects and all levels in the education system. Aside from the classroom teaching, researchers have identified several factors, such as cognitive load, students' support services, and examination malpractice, as factors that can affect students' achievement in Mathematics. Aside from intrinsic cognitive load, extraneous cognitive load is another kind of cognitive load.

Extraneous load, also known as ineffective load, is a major type of load caused by instructional features that are not beneficial for learning. It is a diversion of cognitive resources on activities irrelevant to performance and does not directly contribute to learning. It is caused by factors related to design, such as poor design, presentation format, and non-essential material. Another kind of cognitive load is germane load. Germane load is the effective and beneficial type of load. It refers to the load imposed

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on the working memory by the process of learning. It is the process of transferring information into the long-term memory caused by challenging the student to apply effort toward understanding the material (Kalyuga, 2019).

Cognitive load's influence on students is an important factor to be considered while discussing the academic achievement of mathematics students, especially in the Basic Education Certificate Examination. Cognitive load in this study can simply be put as the work input into the memory of students in an attempt to process information, store information, and communicate thoughts in the process of knowing and understanding a particular learning concept. It has to do with the task on the memory of individuals while learning a given concept. Cognitive load can also be referred to as demands on working memory storage and processing information. Cognitive load is the extent of the difficulty of information, the way it is delivered during instruction, and the mental resources students allot in order to solve a mathematics problem or task adopted (Musa & Aliyu, 2022). It can be seen that the intrinsic load imposed by a learning task can come from either or both the nature of the task and the learners' characteristics. The higher the number of novel interacting information elements a task contains, the higher the intrinsic cognitive load it imposes on working memory. When too many tasks are to be performed at a time, the loads can be combined or chunked into a schema, which is stored in the long-term memory and can be retrieved and handled in working memory as an entity (Olatunji & Ojo, 2023).

Teachers' support services refer to all the services offered by the teachers and directed towards the improvement and success of learning and academic performance of the students (Nathan et al., 2024). Malecki & Demary (2002) define teachers' support services as a teacher giving informational, instrumental, emotional, or appraisal support to a student, in any environment. Informational support is giving advice or information in a particular content area. Instrumental support is giving resources such as money or time. Emotional support is love, trust, or empathy. Appraisal support is giving evaluative feedback to each student (Olah & Utibe, 2024). Teacher support services enhance a teacher's relationship with a student. Specifically, teachers who support students show their care and concern for their students, so these students often reciprocate this concern and respect for the teacher by adhering to classroom norms. When teachers shout at students, blame them, or discipline them, these students often show less concern for their teachers and less cooperative classroom behaviour (Longobordi et al., 2016). These factors often lure them into examination malpractice.

Examination malpractice is any activity of students, teachers, or parents whose purpose is to assist a student to achieve higher grades in a way other than they would likely receive on the basis of their own achievements (Altermatt, 2019). Examination

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malpractice is the massive and unprecedented abuse of rules and regulations that have to do with internal and external examinations, from the setting of such examinations down to the taking of the examinations, the marking and grading, and further to the release of the results and the issuance of certificates (Utibe et al., 2024). Examination malpractices have a paralyzing effect on the developing nation. Examination malpractice can take various forms and ranges from impersonation, leakage of questions, tampering with results, and computer fraud to fraudulent practices by an invigilator (Olatunji & Ojo, 2023). From the forms of examination malpractices aforementioned, it is clear that examination malpractice is not limited to the time and the place of examination. In fact, it occurs either before, during, or after examination.

Over the years, many researchers have conducted studies on the relationship between cognitive load and academic performance among students (Waters *et al.,* 2018; Agah *et al.,* 2022). Others have conducted research on the factors that relates with examination malpractices and the influence of students' support services on their academic performance. However, such relationship studies are not actual indications of what causes students' academic achievement. This is because various factors might contribute to the identified relationship, which may not be a direct effect of the study's variables. In order to determine the causal relationship between cognitive loads, students, support services, examination malpractices, and students' academic performance, causal modeling is a better approach. Causal models or structural equation modeling are mathematical models representing causal relationships within an individual system or population (Nathan *et al*., 2024). They facilitate inferences about causal relationships from statistical data. The most important reason for the use of this statistical technique is that the direct and indirect relationships among causal variables can be measured with a single model (Marley & Wilcox, 2021; Al-Sarry *et al.*, 2022).

Johnson *et al*. (2023) examined the relationship between cognitive load and academic dishonesty among secondary school students in Nigeria. The study investigated how different cognitive load dimensions contribute to cheating behaviours during assessments. Results indicated that extraneous cognitive load had a strong positive correlation with academic dishonesty, suggesting that students overwhelmed by poorly structured learning materials were more likely to cheat. Germane cognitive load was negatively associated with academic dishonesty, implying that students who engaged in meaningful cognitive processing were less likely to engage in cheating.

Ojo & Falade (2023) explored the influence of teacher-student relationships on academic integrity among Nigerian secondary school students. The study aimed to assess whether positive interactions between teachers and students reduce cheating behaviours. Findings revealed that strong teacher-student relationships were significantly associated

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with lower levels of academic dishonesty. Students who reported having supportive and approachable teachers were less likely to engage in malpractice. Okafor & Adekunle (2022) examined the influences of germane cognitive load on student success in mathematics. They aimed to determine whether students who engage in deep cognitive processing achieve better academic results. Their findings indicated that germane cognitive load was positively correlated with mathematics achievement, suggesting that students who actively organize and integrate information perform better.

Wang & Lin (2023) investigated how teacher support contributes to students' academic achievement and ethical behaviour. The study determined the extent to which teacher-student interactions influence learning outcomes and students' moral decision-making in academic settings. Findings indicated that students who received strong academic and emotional support from their teachers were more likely to succeed academically and exhibit higher levels of integrity. The results further revealed that teacher encouragement, feedback, and mentorship played significant roles in fostering student engagement and reducing tendencies toward examination malpractice.

Yusuf & Bello (2023) explored the relationship between teacher support, student self-regulation, and mathematics achievement. Their study assessed whether students who receive greater teacher guidance develop better self-regulated learning behaviours, leading to improved academic performance. Their findings revealed that students who perceived high levels of teacher support demonstrated better self-regulation skills, such as goal-setting, strategic learning, and persistence in solving complex mathematics problems. The study also showed that self-regulation mediated the relationship between teacher support and mathematics achievement, suggesting that teacher guidance fosters independent learning behaviours that contribute to academic success.

Zhang *et al*. (2023) conducted a PLS-SEM (Partial Least Squares Structural Equation Modeling) analysis to predict student cheating behaviour based on cognitive load and teacher support. They determined whether excessive cognitive load increases the likelihood of academic dishonesty and whether teacher support mitigates this tendency. Findings revealed that extraneous cognitive load was positively associated with student cheating behaviour, implying that students who experience high mental strain are more likely to engage in dishonest academic practices. However, strong teacher support significantly reduced the likelihood of cheating, reinforcing the protective role of teacher guidance.

The effectiveness of teachers' support services in reducing cognitive load and preventing examination malpractice in mathematics remains unclear, compromising the accuracy of mathematics achievement measures and potentially limiting students' opportunities for genuine learning and skill development. However, many students

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performed poorly in mathematics. Others go as far as developing hatred for mathematics. In order to achieve high scores in mathematics, some students resort to some form of malpractice. This has really become a serious concern as many students who have recorded high grades in mathematics find it difficult to defend them when it is needed. The researchers, as mathematics teachers, have witnessed different occasions in which some students will leave the class while a mathematics lesson is going on, claiming that mathematics is very difficult for one to understand, but are expected to have a high score in mathematics during the examination. Other students run away from science subjects in school because it is mathematics related.

In furtherance of the above achievement burden, the impact of cognitive load, teachers' support services, and examination malpractice on mathematics achievement is a pressing concern in mathematics education, as these factors can either support or hinder students' ability to learn and apply mathematical concepts. However, the specific relationships between these variables remain unclear, making it challenging to design and implement effective interventions that promote mathematics achievement and academic integrity. This study aims to investigate these relationships to inform evidence-based practices that foster mathematics learning and success.

Purpose of the Study

The main aim of this study was to develop a causal model of cognitive load, teachers' support services in preparing for test and examination malpractice on achievement in mathematics in Akwa Ibom State, Nigeria. Specifically, the study will:

1 Develop a parsimonious model for providing an explanation for students' achievement in mathematics based on the dimensions of cognitive load (intrinsic, extraneous and germane), teachers' support services in test preparation and examination malpractice.

2 Determine the magnitude of direct effects of the exogenous variables on the endogenous variable for this study.

Research Hypotheses

The following hypotheses guide the study and will be tested at a 0.05 level of significance:

1. The model fit between the empirically validated model and the hypothesized model for this study is not statistically significant.

2 The magnitude of direct effects of the exogenous variables on the endogenous variable for this study is not statistically significant.

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Significance of the Study

The finding of this study on causal modeling of cognitive load, teachers' support-services in preparing for test and examination malpractice on achievement in mathematics in Akwa Ibom State, Nigeria would be of immense benefit to students, teachers, parents, and educational administrators. To the students, the findings of this study would help them to understand the different factors that affect their performance in mathematics. The findings of the study would also help them to identify the direct and indirect factors. With such knowledge, the students can work towards the improvement of their performance by working to improve those factors with direct causation of their performance in mathematics. The findings of this study would help teachers to identify how different support factors affect students' academic performance in mathematics. With such understanding, teachers would do their best to help students improve on those factors with direct causation on their performance and manage others in order to improve their achievement in mathematics.

Parents would equally benefit from the findings of this research immensely. Parents who are interested in the advancement of their students' achievement in mathematics would find this study as being timely since the findings of this study would help them to identify different factors that could be responsible for their children's poor performance in mathematics. With such knowledge, the parent would know how to guide and counsel their children to perform better in mathematics, especially in areas that affect their activities.

METHOD

Path analysis co-relational research design, was used in the study. This design attempt at formulation of theory about the possible cause of a given phenomenon by identifying seeming causal variables for the explanation of the occurrence of the phenomenon through practical demonstration to confirm whether the identified variables were consistent with the theory (Knock, 2020). This design was considered appropriate since the researchers are interested in using causal modeling to determine the effect of cognitive load, teachers' support service in preparing for test and examination malpractice on students' achievement in mathematics in Akwa Ibom State, Nigeria.

The State comprising 31 Local Government Areas was created on 23rd September, 1987 with its capital in Uyo. The State is bordered on the East by Cross River State, on the West by Rivers State and Abia State, on the North by Ebonyi State, and on the South by the Atlantic Ocean. The State population is estimated at over 4,805,470 people as of 2006, with a land mass of 7,81Km2 (National Population Commission,

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2006). The State is located in the South-South geopolitical zone of Nigeria, lying between latitudes 4032N of the equator and longitudes 70250E and 80250E of the Greenwich Meridian. Akwa Ibom State has three senatorial zones with 31 L.G.As. Ikot Ekpene and Uyo senatorial zones were used for the study. Ikot Ekpene senatorial zone comprises 11 L.G.A. and 8 L.G.A in Uyo senatorial zone, respectively. There are 92 public secondary schools in Ikot Ekpene zone and 89 public secondary schools in Uyo senatorial zone. Apart from the public secondary schools in the area, there is a good number of private secondary schools. Public secondary schools were used in this study because the schools are managed by the State government, and the students were likely to have similar characteristics.

Ikot Ekpene and Uyo senatorial zones of Akwa Ibom State were chosen for this particular research since the researchers have schooled in the State and has witness different instructional approaches used by many teachers in the State, which need improvement. With interest in contributing to the improvement of mathematics achievement in the State, the researchers were moved to conduct this particular study on the causal model of cognitive load, students' support service in preparing for the test, and examination malpractice in mathematics achievement in Akwa Ibom State.

The population of the study consisted of all 60,821 Junior Secondary Two (JS2) students in 253 public secondary schools in Akwa Ibom State as at 2024/2025 academic session (28499 males and 32322 females). The choice of JS2 students for this study was based on the fact that they have covered most of the junior secondary content area in mathematics, and at the same times their teachers are trying to cover areas where they had lapses in the junior secondary curriculum, and taking advantage of all the available supports that can enhance their academic achievements.

A sample of 936 JS2 Mathematics students was used in the study. The students were selected using a multi-stage sampling technique. At the first stage, two senatorial districts' schools were selected; Ikot Ekpene and Uyo. A sample of 20% of 181 public secondary schools was selected from the two Senatorial Districts in the State, which is 36.2%. Sequel to this, 18 schools were selected from each of the two senatorial zones, Ikot Ekpene and Uyo (36.2/2= 18.1). For Ikot Ekpene senatorial zone with 18 schools, the names of the 92 schools were in strips of paper, folded and placed in the basket. Thereafter, 18 strips of paper, representing 18 schools, were picked, one after the other, without replacement. The same procedure was carried out with the Uyo 89 public secondary schools by the researchers. At the last stage, a proportion of 30% of students was selected from each of the schools to take part in the study, which amounted to 936 students. Al-Sarry et al. (2022) assert that the sample size should not be too small. The sample size is considered adequate for the study as it is above the minimum sample size

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of 200 (Celik & Yalmaz, 2013) for structural equation modeling studies. Four instruments were used in collecting data for the study. These instruments were; Mathematics Achievement Test (MAT), Students' Cognitive Load questionnaire (SCLQ), Teachers' support services in preparing for test questionnaire (TSPTQ), and Examination Malpractice questionnaire (EMQ). Mathematics Achievement Test (MAT) consist of 50 multiple choice items for Junior Secondary two (JS2) mathematics students in Akwa Ibom State. Each item has four response options: A, B, C and D with only one correct option for each item. For the scoring of the MAT, correct response was awarded one mark while an incorrect response was awarded zero. Therefore, the MAT has a maximum of 50 marks for students who got answer to the entire questions correctly and a minimum of zero mark for students who could not answer any question correctly.

The items of MAT were developed by the researchers and validated by three lecturers in the Department of Mathematics of Akwa Ibom State University. The development of the MAT was guided by strict adherence to the junior secondary school Mathematics curriculum using test blueprint that guided the study. The instruments SCLQ, PSPTQ and EMQ were face validated by three experts, from the Department of Science Education, Akwa Ibom State University, Nigeria. They were requested to look at the wordings of the items of the instrument, the language and clarity of the items, the appropriateness of the instructions to the respondents and the appropriateness of the items to the purpose of the study.

The reliability of the instruments were determined by administering the instruments to 50 JS2 students in Eket education zone, using the data obtain from trial testing of the instrument, who were not part of the study but shared similar characteristics that are necessary for the study. The data obtain from the 50 respondents were subjected to analysis. The estimate of internal consistency of the instruments; SCLQ, TSPTQ and EMQ were established using Cronbach's Alpha reliability method. The reliability coefficients of the clusters for SCLQ were 0.88, 0.89, and 0.81, intrinsic, extraneous and germane loads respectively and the overall coefficient was 0.92. For TSPTQ, the reliability coefficients of was 0.82. The reliability of EMQ was 0.85. Cronbach alpha was considered appropriate because the items were polychotomously scored. The instruments are considered reliable as all the reliability coefficients obtained are greater than 0.70 which is recommended to demonstrate a reliable instrument (Nenty & Umoinyang, 2004). Finally, MAT was determined using Kuder-Richardson (KR_{20}) and the coefficient of 0.83 was obtained. Kuder-Richardson (KR_{20}) was considered appropriate because the items of MAT were dichotomously scored. The coefficients for all the instruments were considered high and good enough for the current study.

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The researchers collected the data for the study through administration of the instrument. The researchers make available a copy of introductory letter collected from the Department to make it easy to obtain permission of the Principal to carry out the study in each of the schools. The researchers after obtaining permission to carry out the study explains the purpose of the study and how the study would benefit the students before administering the instrument on JS2 Mathematics students. All the completed instruments were collected at the point of administration to ensure 100% return rate of the instruments in each of the 18 schools in Ikot Ekpene and Uyo Zones.

Data collected were analyzed using Structural Equation Models (SEM), involving a multivariate analytical technique of exploratory factor analysis, and confirmatory factor analysis. Specifically, the hypothesis one was tested by comparing the fit statistic in both hypothesized and the validated model. Hypotheses two was tested using bootstrap 95% confidence interval. The decision rule was to reject a null hypothesis if 95% confidence intervals contain zero, otherwise, the null hypothesis was not rejected.

Out of the 950 copies of the instruments administered, 936 copies were used in the analysis 14 copies of the instruments were improperly filled, hence were discarded. The hypotheses were addressed based on the outcomes of the evaluation of measurement and structure models. In the evaluation of the measurement model, the researchers assessed: (i) the indicator reliability (ii) the indictor reliability was assessed using factor loading. Factor loading > 0.70 were either automatically retained. Between 0.40 and 0.70 were either retained or delete only when doing so increase the internal consistency reliability or the convergent or the convergent validity of the constructs (Hair *et al*., 2022). The internal consistency reliability was assessed using composite reliability rhoC. The acceptable values for rhoC are $\geq$ 0.70 (Hair *et al.,* 2022). The convergent validity was assessed using Average Variance Extracted (AVE). The AVE values $\geq$0.50 is acceptable (Hair *et al.*). The discriminate validity was Heterotrait-Montrait ratio of correlation (Henseler *et al*., 2015). The HTMT value $\leq$ 0.90 are acceptable (*Hair et al.*) whether the HTMT value were significantly lower than the 0.90 were ascertained using bootstrapping procedure at 95% CI.

RESULTS AND DISCUSSION

Figure 1 shows that all the paths are significant. This is because the p-values associated with the beta (β) coefficients of the paths are less than 0.05 level of significance ($p < 0.05$) at which the result was being compared. The model involves students' achievement in mathematics (SAM) as influenced by the dimensions of cognitive load – intrinsic cognitive load (ICL), extraneous cognitive load (ECL), and germane cognitive load

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(GCL), dimensions of teachers' support-services (TSS) in test preparation, as well as students' examination malpractice (SExM). Therefore, the Figure represents the parsimonious model for providing an explanation of students' achievement in mathematics based on the dimensions of cognitive load (intrinsic, extraneous and germane), teachers' support-services in test preparation and examination malpractice."

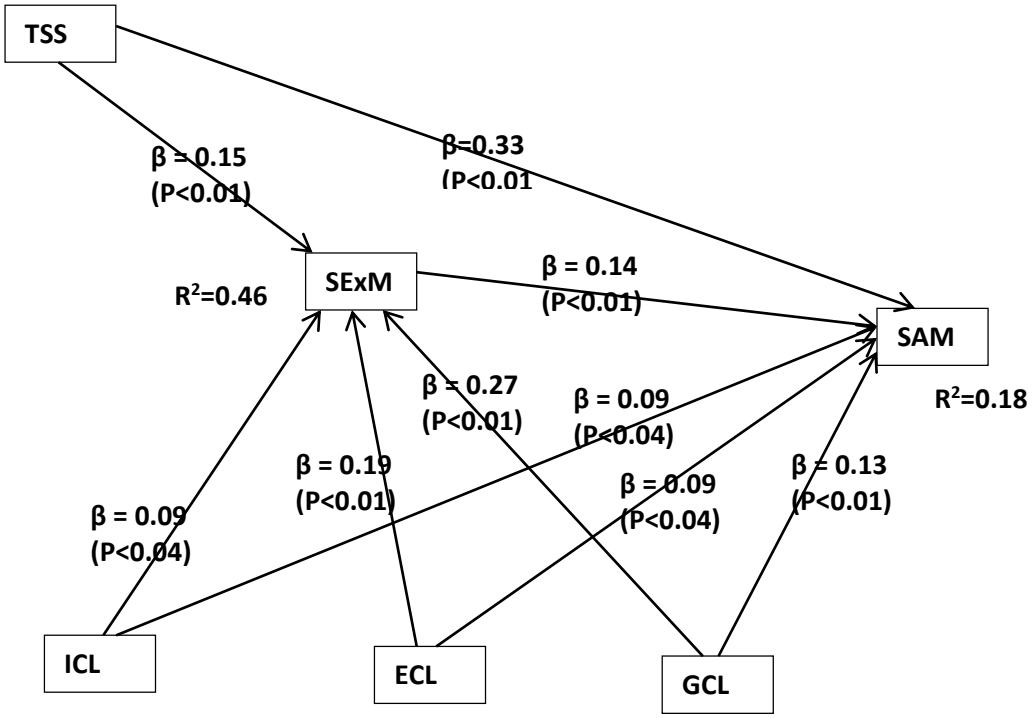

Figure 1: The parsimonious model for providing an explanation of students' achievement in mathematics based on the dimensions of cognitive load (intrinsic, extraneous and germane), teachers' support-services in test preparation and examination malpractice.

Table 1: Magnitude of direct effects of the exogenous variables on endogenous variable for this study

S/N	Path	*β*	Standard Error	Effect Size (f^2)	Magnitude of influence	t-values	p-values	Decision
1.	ICL>SExM	0.09	0.05	0.02	Small	1.79	0.04	S
2.	ECL>SExM	0.19	0.05	0.09	Small	3.71	0.00	S
3.	GCL>SExM	0.27	0.05	0.16	Moderate	5.43	0.00	S
4.	PaSS>SExM	0.15	0.05	0.06	Small	3.00	0.00	S

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5.	ICL>SAM	0.09	0.05	0.02	Small	1.79	0.04	S
6.	ECL>SAM	0.09	0.05	0.02	Small	1.74	0.04	S
7.	GCL >SAM	0.13	0.05	0.02	Small	2.56	0.01	S
8	SExM> SAM	0.14	0.05	0.04	Small	2.86	0.00	S

Note: β =Beta coefficient, S= Significant, NS = Not Significant; $f^2 \geq 0.35$ implies Large effect, $\geq$ 0.15 implies Moderate effect, and $\geq$ 0.02 implies Small effect

Table 1 shows the magnitude of direct effects of the exogenous variables on endogenous variables for this study. The results showed that all the exogenous variables had considerable direct effects on the endogenous variables in the parsimonious model. For students' examination malpractice, the beta (β) weights obtained showed that teachers' support service (TSS) had the highest direct effect on the variable (SExM), with a path coefficient (β) of 0.28 (f^2= 0.16). This means that 1 unit change in TSS will result to a 0.28 (moderate) increase or decrease in SExM. This is followed by students' germane cognitive load (GCL) which had the second highest direct effect on SExM, with a path coefficient of 0.27 (f^2= 0.16). This means that 1 unit change in GCL would account for 0.27 (moderate) increase or decrease in SExM. Next was extraneous cognitive load (ECL), then intrinsic cognitive load (ICL) and parents' support services (PaSS), respectively.

For students' achievement in mathematics (SAM), teachers' support service (TSS) had the highest direct effect on the variable (SAM), with a path coefficient (β) of 0.33 (f^2= 0.19). This implies that 1 unit change in TSS will account for 0.33 (moderate) increase or decrease in SAM. This was followed by SExM, which had path coefficients of 0.14 (f^2= 0.04), indicating that a unit change in SExM would account for a small but substantial direct effect of the variables on students' achievement in mathematics (SAM). The next variables were students' germane cognitive load (GCL), extrinsic cognitive load (ECL), and intrinsic cognitive load (ICL), that had small but considerable direct effects on students' achievement in mathematics, respectively. Summarily, it can be deduced that teachers' support service (TSS) has moderate effect on students' examination malpractice and achievement in mathematics. Students' germane cognitive load also has a moderate direct effect on their examination malpractice in mathematics while other exogenous variables have small but considerate direct effect on SExM and SAM, respectively. Thus, generally, it can be interpreted that the magnitude of direct effects of the exogenous variables on endogenous variables for this study were substantial and ranged from small to moderate level."

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Table 2: Significance of the model fit and quality indices between the empirically validated model and hypothesized model for this study

Model fit and Quality Indices	Estimated indices and threshold for the hypothesized model	Decision	Estimated indices and threshold for the parsimonious model	Decision
Average path coefficient(APC)	= 0.137, P= 0.002	Significant	= 0 .175, P< 0.001	Significant
Average R-squared (ARS)	= 0.314, P< 0.001	Significant	= 0.322, P< 0.00	Significant
Average adjusted R-squared (AARS)	= 0.302, P< 0.001	Significant	= 0.312, P< 0.00	Significant
Average block VIF (AVIF)	=1.695, acceptable if <= 5.00, ideally <= 3.30	Significant	= 1.436, acceptable if <= 5.00, ideally <= 3.30	Significant
Average full collinearity VIF (AFVIF)	=1.704, acceptable if <= 5.00, ideally <= 3.30	Significant	1.436, acceptable if <= 5.00, ideally <= 3.30	Significant
TenenhausGoF (GoF)	= 0.364, small >= 0.10, medium >= 0.25, large >= 0.36	Significant	= 0.372, small >= 0.10, medium >= 0.25, large >= 0.36	Significant
Sympson's paradox ratio (SPR)	= 0.769, acceptable if >= 0.70, ideally = 1.00	Significant	= 0.900, acceptable if >= 0.70, ideally = 1.00	Significant
R-squared contribution ratio (RSCR)	= 0.969, acceptable if >= 0.90, ideally = 1.000	Significant	= 0.976, acceptable if >= 0.90, ideally = 1.00	Significant
Statistical suppression ratio (SSR)	= 1.000, acceptable if >= 0.70	Significant	= 1.000, acceptable if >= 0.70	Significant
Nonlinear bivariate causality direction ratio (NLBCDR)	= 1.000, acceptable if >= 0.70	Significant	= 1.000, acceptable if >= 0.70	Significant
Standardized root mean squared residual (SRMR)	= 0.081, acceptable if <= 0.10	Significant	= 0.090, acceptable if <= 0.10	Significant

Table 2 shows that the model fit and quality indices for both parsimonious and hypothesized causal models are statistically significant ($p < 0.05$); hence, the null hypothesis that there is no significant model fit between the empirically validated model and hypothesized model for this study was rejected. This implies that there is a significant model fit between the empirically validated model and hypothesized model for this study. This can be interpreted that the data obtained for the study fits and supports the model developed. Therefore, the conclusion drawn is that there is a significant model fit between the empirically validated (parsimonious) model and hypothesized model for this study, which provides explanation of students' achievement in mathematics based on the dimensions of cognitive load (intrinsic, extraneous and germane), teachers' support-services in test preparation and examination malpractice.

Table 1 indicates that the magnitude of direct effects of the exogenous variables on endogenous variables in the parsimonious causal model developed is statistically

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significant. This is because the p-values associated with the t-values obtained for the direct influence of each of the exogenous variables on the endogenous and criterion variable in the model are less than 0.05 level of significance at which the hypothesis was tested." This implies that the various exogenous variables in the parsimonious model contributed meaningfully to students' examination malpractice (SExM) and students' achievement in mathematics (SAM), respectively. Therefore, the null hypothesis that the magnitude of direct effects of the exogenous variables on endogenous variable for this study is not statistically significant was rejected, and inference drawn was that the magnitude of direct effects of the exogenous variables on endogenous variables for this study in the parsimonious causal model developed is statistically significant.

The study developed a parsimonious causal model explaining students' achievement in mathematics. The final model retained cognitive load dimensions (intrinsic, extraneous, and germane), teachers' support-services and examination malpractice. The model fit indices were statistically significant, confirming the hypothesized and empirically validated (parsimonious) models' adequacy. Thus, there was a significant model fit between the empirically observed data and theoretical model proposed for the study. This strong model fit and structural validity observed can be attributed to the robust theoretical underpinnings and methodological rigour applied in the model's development. The inclusion of cognitive load dimensions, teachers' support services and examination malpractice as key predictors aligns with contemporary educational psychology and test-taking behaviour theories. For instance, the findings align with cognitive load theory which posits that intrinsic, extraneous, and germane loads significantly impact learning and performance, while teachers' support services serve as essential scaffolds in students' academic success. The statistical significance of the hypothesized model suggests that the selected variables collectively provide a comprehensive explanation of students' achievement in mathematics. The empirical validation process, which involved trimming non-significant paths, further refined the model, ensuring that only the most relevant predictors were retained.

The significant fit indices further reinforce the credibility of the model in explaining students' achievement. These indices confirm that the relationships among the latent variables are neither spurious nor trivial but substantively meaningful. The strong alignment between the hypothesized and validated models suggests that cognitive load factors and institutional support systems significantly influence students' engagement and performance in mathematics.

The above findings corroborate with the work of Zhang *et al*. (2023), who conducted a PLS-SEM analysis on cognitive load and academic achievement, reported model fit indices similar to those found in this study, highlighting the importance of

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cognitive load in shaping students' outcomes. The findings also show that all exogenous variables had direct effects on students' examination malpractice and students' achievement in mathematics. Germane cognitive load (GCL) also had a moderate direct effect on students' examination malpractice, while other exogenous variables had small but significant direct effects. The direct effects observed in this study, germane cognitive load (GCL) on both examination malpractice and students' achievement in mathematics, can be explained by the pivotal role of instructional quality and students' ability to process learning effectively. Parents play a supportive role in guiding students through complex problem-solving tasks, mitigating extraneous cognitive load, and fostering an environment that discourages examination malpractice (Kalyuga, 2019). The finding that germane cognitive load (GCL) had a moderate direct effect on examination malpractice suggests that students who develop deep processing strategies are less likely to engage in unethical test-taking behaviours. This agrees with the cognitive load theory, which posits that effective cognitive processing enhances understanding and learning outcomes.

Furthermore, the direct effects of extraneous and intrinsic cognitive load on examination malpractice and mathematics achievement indicate that when students face overwhelming or irrelevant cognitive demands, they are more likely to engage in academic dishonesty. Extraneous cognitive load, which results from poorly structured instructional materials, was found to have a significant positive relationship with examination malpractice, suggesting that students who struggle with information overload may resort to cheating as a coping mechanism. The above finding is largely inconsistent with the results of Musa & Aliyu (2022) who reported that while cognitive load factors were significant, students' motivation levels played a more critical role in determining academic dishonesty. Additionally, a large-scale study by Johnson *et al*. (2023) confirmed that students with high extraneous cognitive load were at greater risk of engaging in malpractice, reinforcing the need for well-structured instructional strategies.

CONCLUSION AND RECOMMENDATIONS

The study has developed and validated a causal model explaining students' achievement in mathematics based on cognitive load dimensions, teachers' support services and examination malpractice. From the model, germane cognitive load has a meaningful direct effect, reinforcing the importance of deep cognitive processing in learning. Conversely, examination malpractice had only a small direct effect on achievement, suggesting that while cheating may provide temporary gains, it does not significantly enhance mathematical competence. Thus, cognitive load dimensions and teachers

support services has considerable contribution to students' engagement in examination malpractice and their achievement in mathematics.

Based on the findings from the study, the following recommendations were made: Students should integrate self-regulated learning techniques and study skill on germane load to improve their overall academic achievement. Teachers should be seriously involve in their students learning activities by providing them effective teaching and education material to improve achievement in Mathematics and parents should be seriously involve in their students study/learning activities by providing their ward with necessary education material and study time at home to improve achievement in Mathematics.

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