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An assessment of the Mathematics Value (MaV) scale's Predictive Estimate's Usability for Mathematics Better Performance Sustainability

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Abstract
This study evaluated the predictive estimate of the Mathematics Value Scale (MaVscale) for mathematics achievement among Senior Secondary One students in Nigeria and its potential for sustaining improved performance. The MaVscale, measuring traits, reasoning, intelligence and problem-solving skills, was administered to [illegible] students across [illegible] schools. Multiple regression analysis revealed that the [illegible] components collectively explained only [illegible] of the variance in mathematics achievement (R^2 = [illegible]), indicating minimal immediate predictive power. Nonetheless, the scale effectively captures students' attitudes, beliefs, and dispositions toward mathematics, providing valuable insights for designing targeted interventions. Findings suggest that while MaVscale alone may not strongly predict achievement, it is a useful tool for fostering motivation, engagement, and long-term learning. Integrating MaV assessments with instructional quality and institutional support, and [illegible] the [illegible] contributing to performance and support sustainable educational outcomes.

Keywords: Mathematics Value scale, Prediction, Innovative research, Performance sustainability

Introduction

Mathematics Value (MaV) encompasses the beliefs, attitudes, and perceptions that students hold towards mathematics, influencing their engagement and performance. Recent studies have highlighted the multifaceted nature of MaV, integrating cognitive, emotional, and behavioural dimensions.

For instance, a study by Lee and Kim (2023) applied explainable artificial intelligence (XAI) techniques to analyse PISA 2018 data, identifying key predictors of mathematics achievement across ten countries. The study found that students' attitudes towards mathematics along with socio-economic factors and study time, significantly influenced their performance. This underscores the importance of fostering positive mathematical attitudes to enhance achievement. Similarly, Fang & Scott (2023) examined the competencies [illegible] in various mathematics curricula, such as problem-solving, reasoning, and creativity. Their findings suggest that students' values, including their appreciation for these competencies, play a crucial role in their learning outcomes. This highlights the need for curricula that align with students' values to improve engagement and performance.

Furthermore, [illegible] et al.'s (2023) study demonstrated how integrating sustainability concepts into undergraduate mathematics education can enhance students' engagement and perception of the subject's relevance. This approach aligns with the growing emphasis on contextualizing mathematics education to make it more relevant to students. These studies collectively emphasise that Mathematics Value is not a static trait but a dynamic construct that can be influenced by educational practices, curricula, and external factors. Understanding and enhancing MaV can lead to improved student outcomes and a more sustainable approach to mathematics education.

Innovation is an active process of facilitating, [illegible] making changes to [illegible], especially by introducing new methods, ideas, or products, while Research is the methodical [illegible] of data and analysis [illegible] in order to establish facts and reach new conclusions ([illegible] et al., 2025). This implies that innovative explanation is a type of explanation that establishes [illegible] by making changes to what had been established. Innovative explanation is a dynamic approach that integrates creative and logical thinking to develop new [illegible] across [illegible] disciplines. It emphasizes [illegible], stakeholder participation, and the synthesis of different methodologies to address complex

challenges.

Iqbal & Ibrahim (2020) provide a good overview of the methods needed to solve the environmental issues we face in today's world and also discussed the innovative applications, while calling for more research on the human exploration methodologies needed to design thinking, crowdsourcing, data mining, AI and machine learning, as well as participatory action methodologies to overcome myths but also to explore ways to find solutions to these problems that would heighten the efficiency and effectiveness of political and economic systems (P10). The overall characteristics of mainstream exploration are termed Colonial Forms that overshadow the experiences and perspectives of individuals using that system and both applicable and purposeful. This approach involves engaging stakeholders throughout the exploration process to co-create results that truly address their perceptions. It implies that, Mathematics Value Scale (MVScale) is an instrument that can be used in the process of scientific exploration (Jones-Oliveira, 2023).

According to Brett (2015), some of these methodologies for exploration can employ to Early childhood schools design thinking, participatory exploration, action exploration, interdisciplinary collaboration, and inclusion of advanced technologies. Design thinking is a creative, user-centered approach that focuses on understanding problems deeply, ideating novel solutions, prototyping, and testing them (Liedtka, Hölscher & Strahle, 2018). MVScale was developed from the Colonial shape like circle and logical thinking. It implies that, to form knowledge, MVScale is an essential tool that can be used. Participatory exploration involves stakeholders directly in the exploration process through focus groups, interviews, and checks, e.g., that students' perspectives are at the heritage. Inclusive development started with exploratory and an exploration that involved laboratories of other disciplines like the mathematics researchers, mathematics teachers and mathematics scholars.

Action exploration is a cooperative approach that combines exploration with practical action, aiming to solve real-world problems and promote practical change through actions, which is one of the main objectives of developing MVScale. Design Thinking, 2020). Also, interdisciplinary collaboration in innovative exploration frequently transcends traditional disciplinary boundaries, bringing together different perspectives to tackle complex problems. Effective exploration enhances creativity and leads to better quality solutions, while participatory exploration involves researchers' duty of research, access, and benefit to participants, ensuring the successful operation of advanced technologies means integrating technologies similar to artificial intelligence (AI) and machine learning can significantly enhance the exploration process, enabling the analysis of large datasets and the development of intelligent models. Park, Cardoso, Gandolfi, Mensah, & Mensi (2023) discovered, while in India-based school exploration similar to the element of history of artifacts (MVS) as classic and original schoolteacher education. So, lack of time to engage with instruments to develop and apply educational effects, and the underrepresentation of African education systems in MVS exploration literature.

The United Nations Organization (UN) is a representative of the significance of a sustainable mindfulness, and has stressed the significant part that education plays in the transformation to the new world of sustainable development. Education contributes to sustainability in two ways, one of which is learning of people of all grade establishments, including basic values, ways and conduct to ensure environmental protection and conservation. The other is encouraging individual sustainability and promoting social equity and welfare through the development of productive ways to accelerate and maximize advances and capability (Mata-Pastor, Ramos & Martínez, 2021). All these may not be realized without mathematics, as almost all the values of ways needed for the profitable sustainability can be acquired through mathematics learning (Jones-Oliveira, 2023). But Mathematics a key for the sustainable development achievement doesn't often result for the learners' mathematics further achievement is evident.

Past achievement in Mathematics is an issue of concern and it has become a matter of serious global concern. Chand, Chaudhary, Prasad & Chand (2021) sought the views of mathematics scholars, associate heads of departments, and academic heads with respect to the causes of poor achievement in Mathematics in the schools grades 9 in secondary institutions and the study found out that the schools had a negative impact

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negative values is a concise presentation or representation of negative attitude or negative disposition. In academic terms, a negative attitude toward mathematics means students may feel anxious or stressed when learning mathematics, believe they are not good at mathematics (low self-efficacy), perceive mathematics as unimportant or boring, or avoid engaging with mathematics-related tasks or courses. These negative feelings can hinder students' learning motivation, participation, and ultimately, achievement in mathematics (Mbonyi et al., 2024; Ozturk et al., 2024; Ingabire et al., 2025; de Mello et al., 2023). This is the reason Kwaa-Mensah (2023) mentioned the importance of effective communication when exposure to the field work. Further also, Mathematics, being a largely self-driven field of study, is largely linked to success in communities society as it is considered a necessary skill (Ogwo & Ojiaeng, 2024).

According to Edumedia (2024), in 2020, 71.13% of candidates obtained five credits, i.e. Mathematics. The 2021 WASSCE results showed a remarkable improvement, with 81.9% of those who sat for a general Mathematics. In 2022, the pass rate declined slightly to 76.13% with a drop from the former year. But, 2023 results with 79.81% of candidates obtaining five credits including Mathematics. This indicated a modest recovery and a stabilization in students' performance after the fall in 2022. The results suggested that some of the challenges from the former years had been addressed, although there remained room for improvement. However, the 2024 WASSCE Mathematics results showed a 72.13% pass rate, representing a 7.68% decline compared to the 2023 results (Superintendent, 2024). This decline indicates a concerning fluctuation and lack of consistency in students' performance in Mathematics over time.

The findings of Igwe & Ijeoma (2024) revealed that students' poor Mathematics is the main factor of their poor performance and also recommended that the educators, parents, and stakeholders should work together to deal with learners' mathematics performance. Learners' perceptions may explain parent choice as to studying courses and enrolling at how to not eradicate, attainable investments grounded on the child's aspirations. Furthermore, Chand et al. (2021) employed social psychology to study in Queensland, highlighting the critical role of mathematics perceptions in primary schools, lowering the focus on male, and emphasizing universal assessment methods. Some other reasons for learners' Mathematics poorer performance are through the learners' negative perceptions, attendance, gender and focus, since all these especially the learners' orientation had been measured through Mathematics and set up to be efficient, Mathematics' attitudes can be established as the challenge for the learners' poorer performance in mathematics (Ikwuka Ofurum, Ndubisi-Nwoke & Ikwuka, 2021).

For decades, learners' poorer performance have been declining. It was recommended that, more skills in Mathematics should be considered using a psychometrically validated scale for continued self-assessment (Kwaa-Mensah, Gligorić & Zaksaitė, 2024). The Mathematics scale in the study was a psychometric tool for the Mathematics that reflects certain key aspects of learners. The scale will be utilized to measure the various mathematical proficiency of the students and forecast the expected future performance status of participants' students. Predictions of Mathematics students' performance can prove educational progress. As discovered, the Students' Performance Prediction (SPP) aims to measure the predictive power of machine learning in a variety of learning environments. This SPP also facilitates the progress of personalized education (Zhang, Yun, Xu, Cui, Murad & Meng, 2021). Thus, gaining perceptions into learners' performance and predictors of academic achievement in Mathematics, should be a common field of study for researchers.

Students' performance in mathematics remains inconsistent despite numerous educational interventions and attempts to enhance teaching strategies. We have just seen one more instance a prevalence of faculty in observing consistent and long-lasting progress in mathematics results. This discrepancy calls into question the efficacy of the current study, and the necessity of gaining a deeper understanding of the variables affecting student outcomes.

This encompasses students' view on mathematics as one of the main factors influencing their performance in the subject. Their motivation,

engagement, and motivation to persevere in the face of difficulties are all strengths reported by these users, scientists, and beliefs, even mathematics. Although technology and innovative teaching methods are considered beneficial, there is still a lack of instruments that can accurately assess and forecast students' long-term performance based on these various related variables.

To evaluate these values and provide predictive information about students' academic aptitude in mathematics, the Mathematics Value Scale (MVS) was created. Its application as a valuable tool for monitoring students' performance, however, has not been thoroughly investigated. Therefore, the purpose of this study is to evaluate the predictive estimates of the MVS scale in order to help learners achieve mathematics more successfully and better.

Research Objectives

The main objectives of this study are:

i. to determine the mathematics values predictive estimates for mathematics achievement among senior secondary I students in Nigeria.

ii. to assess the predictive estimates stability for the mathematics value performance across gender.

Research Questions

i. What is the mathematics value's predictive estimate for mathematics achievement among senior secondary I students in Nigeria?

ii. Is the predictive estimate's stability for the mathematics value's performance across gender?

Methodology

The study had descriptive survey as its research design. The strengths of survey research that include generalizability, reliability, and versatility by (Mandelin, 2015), which the study proposed to measure in the MVS scale, its usage. The study target population comprises all the Senior Secondary one (SS1) student in Nigeria. A multistage sampling technique was adopted at three stages to select six schools in each of the selected two States: a simple random sampling

was adopted to select two South-West (one from peripheral zone), Ondo State and Osun State respectively, selected out of the six States in the zone. Six schools (three private and three public) were randomly selected from the three senatorial districts in each of the two selected States. A total of 1,200 SS1 students were randomly selected for the study from the twelve selected schools (6 Ondo and 6 Osun State).

The Mathematics Value scale (MVS) scale was initially constructed from the seven mathematical components captured by the researchers. A 7-item Mathematics valuation's interview schedule (MVIS) was prepared and used to extract information from the Mathematical educators, from which the seven components (basic skills, reasoning skills, intelligent skills, emotional intelligent skills, problem solving, and time management skills) were discovered. Then, a 70-item scale was initially constructed, from which 35-item scale was developed through rigorous tests and analysis.

Its test for its study were collected among the 1st Cycle Mathematics. Four months was used for the data collection. The researcher used a month to prepare the Mathematics teachers in the 12 selected schools on research instruments and test administration. In the second month, the researcher and the assistants administered the instruments to the selected students in all the selected schools.

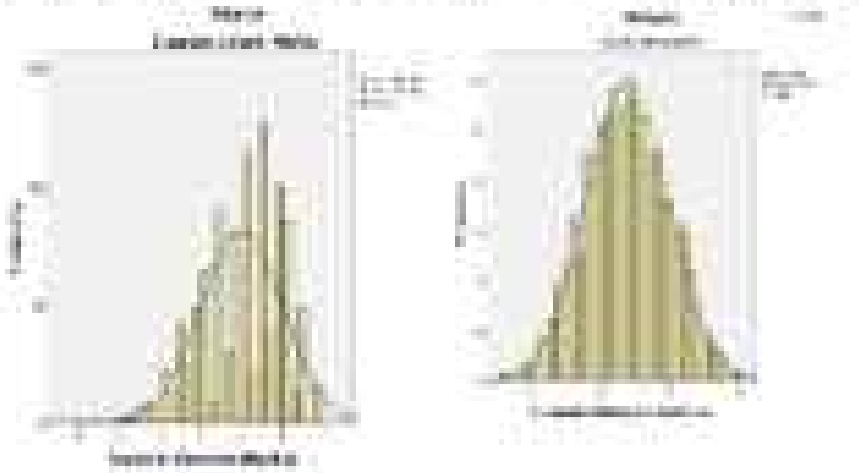
Statistical Analyses

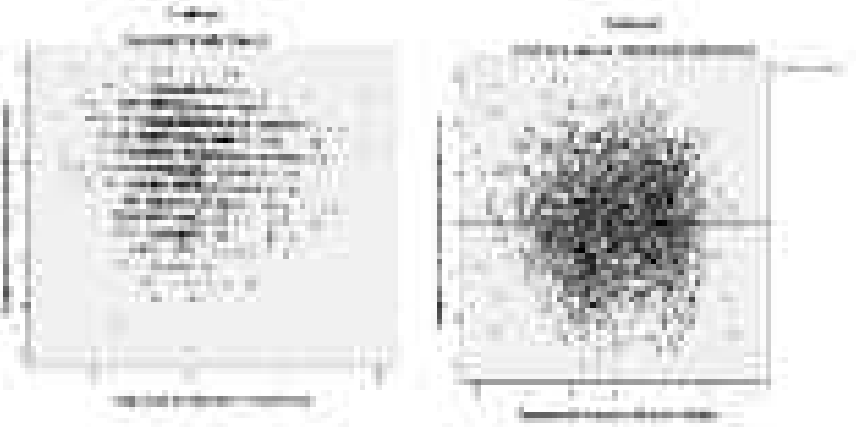
The data collected was analyzed using multiple linear regression in SPSS version 26 and psych() function in R studio. The results of analysis and discussion of findings are briefly presented.

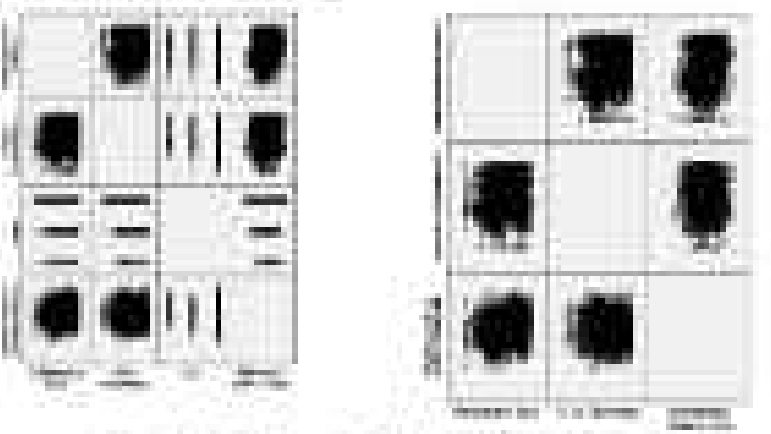
In order to analyses to answer the two research questions that have been stated for the study, the regression data was tested for the main assumptions for multiple linear regression using SPSS. The results of the assumptions were shown in figures 1 to 3.

Figure 1: the test of assumption results for Cook's regression analysis

A: Normality assumption was tested







[illegible] In Figure 2.

To achieve the research question 1, Multiple Regression technique in SPSS was used, before applying the results as produced in the results. The results of the Multiple Regression Analysis displaying the Model Summary in Table 1 and the Statistical Significance of the four Mathematics competencies in Table 2 were thereby presented.

Table 1: The model summary of the four competencies of Mathematics for mathematics achievement

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.869[a]	.755	.682	14.7712

a. Predictors: (Constant), Basic Skills, Intelligent Skills, Reasoning Skills, Problem Solving Skills

Table 2 shows the coefficients of the four components of Mathematics Multiple Regression Analysis.

Table 2: Coefficients of the four components of Mathematics multiple regression analysis.

Model		Coefficients[a]				
		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	T	Sig.
1	(Constant)	21.548	1.315		24.501	.000
	Basic Skills	-.046	.048	.021	-.432	.437
	Intelligent Skills	.281	.242	.041	.833	.407
	Reasoning Skills	.143	.225	.029	.634	.527
	Problem Solving Skills	8.8	.019	.887	.169	.866

a. Dependent Variable: Mathematics Achievement

[illegible]

Discussion of Findings

[illegible]

[illegible] studies [illegible]. Nonetheless, [illegible] gender and [illegible] engagement, [illegible] learning behaviour.

Recommendations

[illegible] should be [illegible] factors such as teaching quality, [illegible] parental [illegible] Future research should [illegible] interaction between [illegible] and contextual [illegible] mathematics [illegible].

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