Usability of Mathematics Value Scale (MaVscale) to Promote Learning in Secondary Schools for Innovative and Educational Development Sustainability

RESEARCH ARTICLE

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ABSTRACT

Developing and validating a Mathematics Value Scale (MaVscale) among senior secondary students has received minimal attention in previous research, which largely focused on the significance of Mathematics Value and its antecedent elements through survey and experimental studies. This study therefore aimed to establish the usability of the newly created MaVscale among Nigerian senior secondary students. The scale included dimensions such as basic, intelligence, reasoning, and problem-solving skills. Both Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) confirmed the suitability of MaVscale for usability. Fit indices were as follows: Standardised Root Mean Square Residual (SRMR) = 0.04 (close to zero), Tucker-Lewis Index (TLI) = 0.94 (greater than 0.90), Goodness-of-Fit Index (GFI) = 0.91, Adjusted Goodness-of-Fit Index (AGFI) = 0.89, Normed Fit Index (NFI) = 0.92, Comparative Fit Index (CFI) = 0.95, and Root Mean Square Error of Approximation (RMSEA) = 0.05. These results indicate that MaVscale is valid and reliable for measuring mathematics values. Hence, MaVscale is accepted as a usable tool for promoting learning in secondary schools, thereby fostering innovation and supporting educational development sustainability.

Methodology

Exploratory and Confirmatory Factor Analysis using data from 1,300 SS1 students across Nigerian schools

Key Dimensions

Basic skills, intelligence skills, reasoning skills, and problem-solving skills in mathematics

Main Finding

MaVscale demonstrated strong validity and reliability with excellent fit indices for practical use

Keywords: Mathematics Value, Value Scale, Factor Analysis, Usability, Skills

INTRODUCTION

Mathematics is a crucial subject for excelling in various fields, instilling practical values that foster responsible adults and economically prosperous communities. These values manifest as developed mathematical functional skills. Research indicates that students' value beliefs significantly predict their mathematics performance and achievement (Henschel & Roick, 2017). Furthermore, social goal orientation positively impacts help-seeking behaviour and mathematics achievement (Abebe, 2025), underscoring the vital link between values and educational success.

As an essential subject in daily life, Mathematics encompasses numbers, shapes, statistics, measures, and logical reasoning. Its importance extends across all fields, including economics, engineering, finance, medicine, and natural science (Textbook, 2023). Mathematical skills are vital for both academic success and daily functioning, facilitating self-regulated learning and lifelong development (Brezavšček et al., 2020; Mejeh & Held, 2022). In our mathematically dominated universe, sustained innovation and educational development rely on students' consistent performance and value-driven mathematical competencies, fostering adaptable, self-directed learners.

01

Mathematics Perception Challenge

Despite its importance, many people despise Mathematics and consider it the worst subject due to its perceived difficulty and confusing nature.

02

Negative Attitudes Impact

Students often find no value in Mathematics, with some saying, "It simply robs you of your happiness and time" - affecting learning outcomes.

03

Need for Value Recognition

There is a critical need to help students **recognise** the practical skills and values that Mathematics develops for future success.

However, Trustradio (2025) asserted that many people despise and avoid Mathematics, some finding no value in it due to its perceived difficulty. Swiftie, in TopTheTen (2025), even ranked Mathematics as the worst school subject, stating: "It is a subject whereby you just keep looking at the same data and doing the same thing. You will never use it in your life, either. It simply robs you of your happiness and time."

Despite this, multiple factors influence individuals' attitudes towards Mathematics. Boaler (2012) notes that mathematics anxiety often develops because students are taught to memorise rules and formulas rather than understand concepts. Therefore, fostering student interest and mastery of mathematical fundamentals is essential.

According to Offiong (2009), arousing the interest of students requires parents to support their children in developing a positive orientation towards Mathematics. Parents can make Mathematics fun at home. Additionally, passionate teachers who adopt varied teaching resources and strategies –such as experiments, hands-on activities, real books, music, rhythm, and games–are crucial. As the brain learns in multiple ways, the more teaching methods used, the better the comprehension. Therefore, it is unsurprising that students find lessons with visual components more engaging and easier to relate to, even mentally, through instruments like the Mathematics Value Scale (MaVscale).

MATHEMATICS VALUE SCALE (MaVscale) DEVELOPMENT

MaVscale is a standardised assessment instrument (Isaac-Oloniyo et al., 2021) designed to gauge students' mathematical value. It was developed as a diagnostic tool to evaluate students' mathematical ability, including their orientation or beliefs about the subject, the practical skills they acquire, their progress, and predictions of future Mathematics performance.

Its development was based on three primary theories: Value Theory, Value Orientation Theory, and Validation Theory. In this study, Value Theory was used to address the question of how and why people value certain things (Hitlin & Piliavin, 2004). According to Eccles and Wigfield (2002), Expectancy-Value Theory explains how students develop values and beliefs that shape their engagement with Mathematics. The generalisability of such measures can be evaluated using Generalisability Theory, as outlined by Brennan (2001). Reliability theories, including classical test theory and generalisability approaches, remain essential for validating constructed educational instruments.

Theoretical Foundation

- Value Theory - understanding how people value things
- Value Orientation Theory - beliefs construction
- Validation Theory - instrument reliability
- Generalisability Theory - global applicability

Assessment Purpose

- Evaluate mathematical ability and orientation
- Measure practical skills acquisition
- Monitor student progress
- Predict future Mathematics performance

A Value Scale Development Framework can be grounded in the Expectancy-Value Theory proposed by Eccles and Wigfield (2002), combined with the principles of instrument validation outlined by DeVellis (2017) and the reliability foundations provided by Cronbach (1951). These well-established theories support the conceptual clarity of mathematical value and guide the development of valid, reliable, and usable measurement scales.

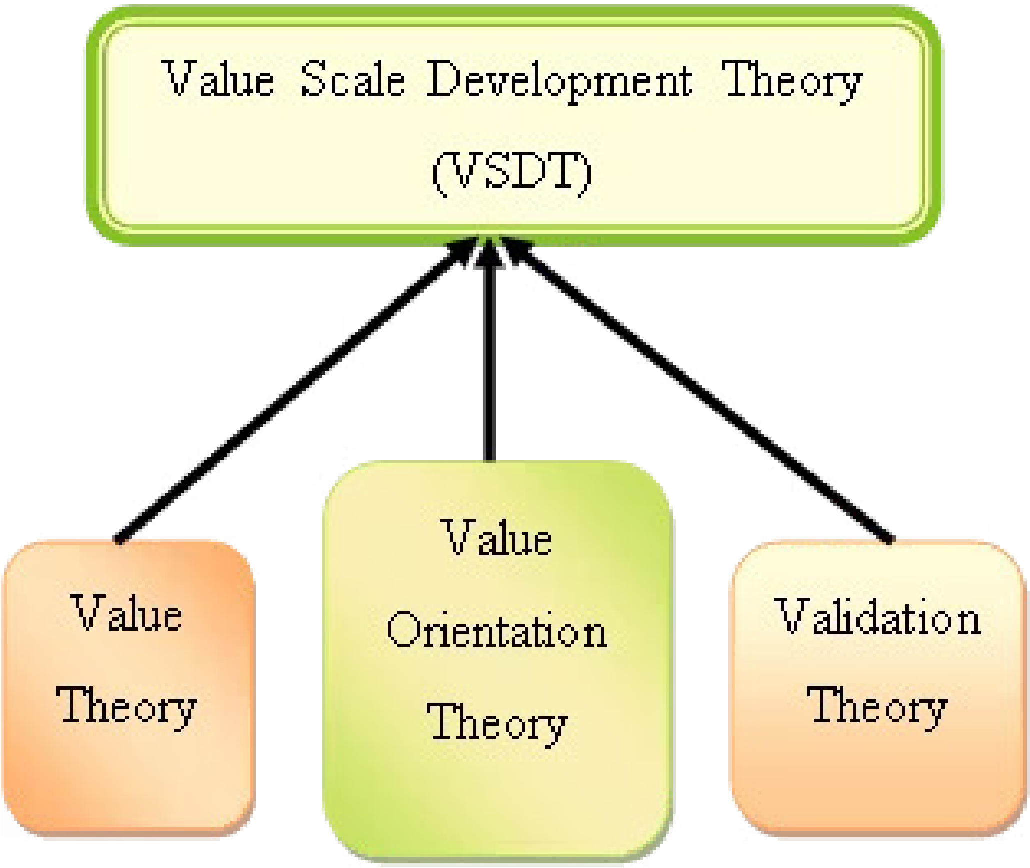

Figure 1: Theoretical Framework for the Study

Source: Isaac-Oloniyo (2023).

MaVscale development also drew on Aristotle's notion of value in use and value in exchange (Fogarty, 1996). In essence, what you offer can be exchanged for what you need. By implication, the value in Mathematics (skills) can be accessed by the value placed on Mathematics (orientation). The skills that can be developed from learning Mathematics are numerous, but MaVscale was developed from seven functional skills that served as its content sources.

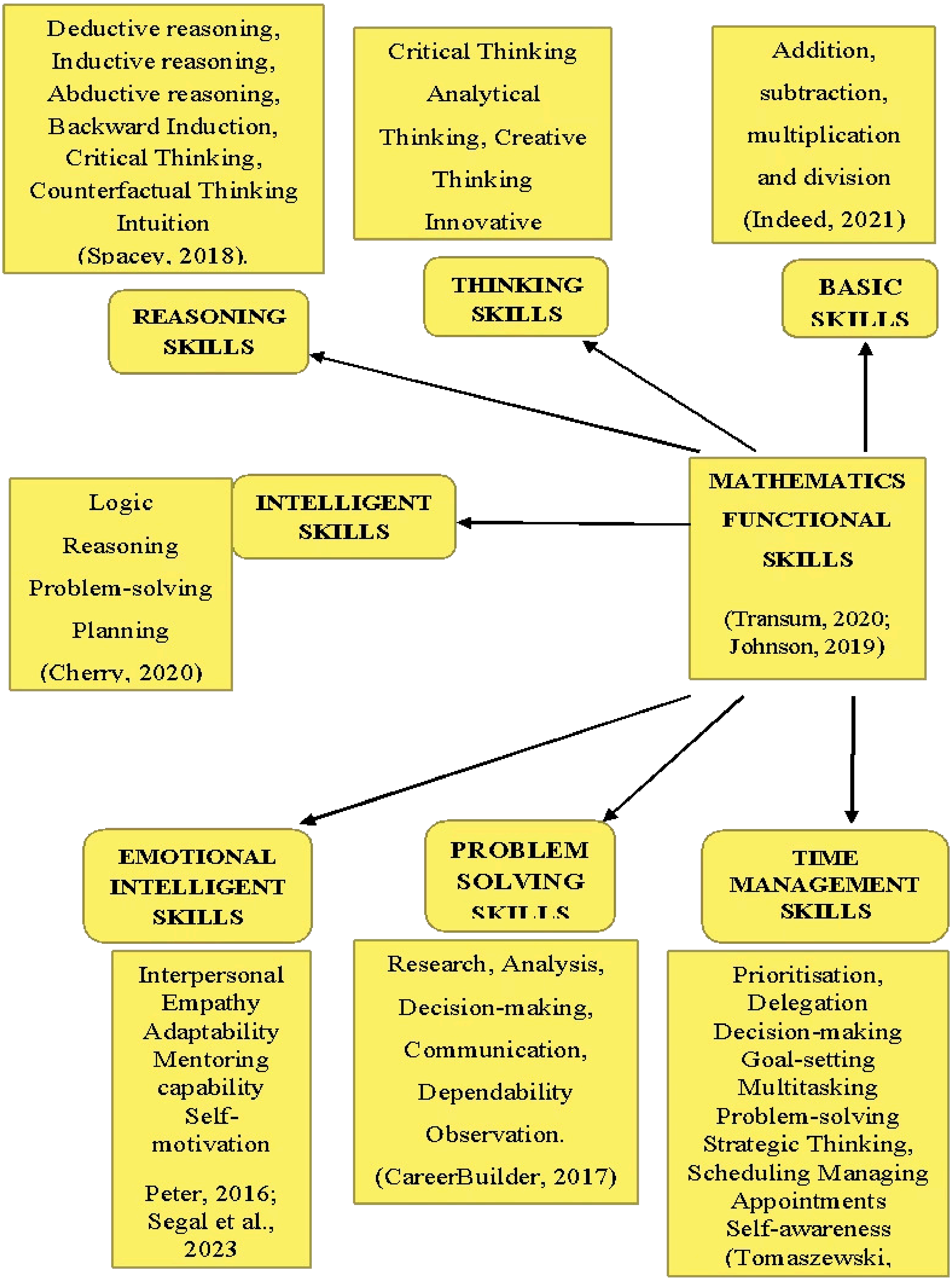

Figure 2: Mathematics Functional Skills.

Source: Isaac-Oloniyo (2023).

For scale development, the skills in each component must be found reliable and valid before **utilisation** (DeVellis, 2012). These can be established through repeatability and usability tests, which also help identify respondents' challenges and address usability concerns (MeasuringU, 2022). MaVscale usability testing **focussed** on identifying and resolving usability problems (Maze, 2025). Cazañas et al. (2017) demonstrated that the five-user rule of sample size significantly underestimates the number of usability problems detected. Several studies claim that three to five users can identify up to 80% of issues.

There are other scales for measuring constructs in Mathematics that differ from MaVscale, such as the Math Anxiety Scale (Richardson, 1972) and the Scale for Problem-Solving Skills in Mathematics. Value Orientation Method (VOM) (Gallagher, 2001) and Learning Orientation Model (LOM) (Martinez, 2010) are also relevant. Sound research techniques and trustworthy data rely heavily on the validation of scales, whether newly created or adapted from earlier contexts. In the field of agricultural and extension education, proper scale development and validation ensure that findings accurately reflect the desired underlying constructs. Content, response process, internal structure, external structure, and consequences are the five validation domains essential for robust scale development (Lamm et al., 2020). A thorough literature review should, therefore, include checks on external structure validity, initial content validity, and the developmental stages of scale construction, while also identifying similar scales.

STATEMENT OF THE PROBLEM

Mathematics is a vast and complex discipline that requires creativity, reasoning, connection-making, and method interpretation. It is a collection of concepts that shed light on the world and is continually evolving. Many skills can be developed through the teaching and learning of Mathematics. These abilities are also known as mathematical value. However, some people have a negative view or orientation towards Mathematics, which makes it unpleasant for students, rather than seeing it as resourceful, valuable, and helpful, according to the findings of certain studies. This negative orientation is reflected in concerning national performance trends. For instance, in 2020, only 39.82% of WASSCE candidates in Nigeria achieved five credits, including Mathematics, marking a significant decline exacerbated by COVID-19 disruptions (Adetula, 2024). Recent WAEC results reveal alarming mathematics performance trends in Nigeria. In 2024, only 72.9% of candidates achieved five credits including Mathematics and English Language, representing a 7.6% decrease from 2023 (Onwuka, 2024). Lagos State alone recorded a 54.3% failure rate in the 2024 WASSCE despite investing N1.57 billion in examination fees (Salau, 2025). Furthermore, a decade-long study (2000-2009) of NECO-SSCE results revealed pronounced regional disparities, with the North-East zone consistently demonstrating the lowest mathematics performance, while the South-South zone ranked highest (Utibe & Agwagah, 2015). Recent analyses using population growth models also indicate an extremely slow rate of student progression in mathematics skills, signalling sluggish advancement in mathematical competency across the nation (Agbanaka et al., 2023). Such orientations are necessary for innovation and the sustainability of improved Mathematics performance amongst students.

Various strategies have been used to address this issue, such as the work on growth mindset, which was initially developed by Boaler's Stanford colleague, Carol Dweck, to dispel myths by encouraging and teaching students to think differently. Even more damaging is the widespread misconception that those who are good at Mathematics are the smartest or most intelligent individuals. This makes Mathematics failure especially devastating for students, who interpret it as a sign of inferiority.

In the meantime, these persistent poor performance trends underscore the urgent need for comprehensive work in the areas of Mathematics Value and Value Orientation. Without a deeper understanding of students' value orientations toward Mathematics, these declining and stagnant performance trends are likely to continue. While existing mathematics assessments focus primarily on cognitive achievement, there is a critical gap in measuring students' value orientation toward mathematics - their beliefs about its practical utility, relevance, and connection to future success. This value-orientation gap may explain why students continue to underperform despite curriculum reforms and increased investment. According to UNESCO's SDG 4 monitoring, over 60% of children and young people in Africa are not meeting minimum proficiency requirements in mathematics (Africa Sustainable Development Report, 2022). This mathematics literacy crisis directly threatens sustainable development goals, as mathematical competency is fundamental to innovation, economic development, and evidence-based decision-making required for sustainable societies. Therefore, tools are needed so that students can be assessed for their mathematical worth, weaknesses can be identified and addressed, and innovation and educational development can be sustained. As a result, the Mathematics Value (MaV) Scale was created and refined to encourage secondary school students to promote Mathematics learning for innovative and educational sustainable development in Nigeria.

Core Problem

Negative orientations toward Mathematics prevent students from recognising its value and developing essential skills for innovation and sustainable development, as evidenced by significant performance declines and disparities in national examinations.

Misconceptions Impact

Widespread belief that mathematical ability equals intelligence makes failure devastating and creates barriers to learning and engagement, contributing to sluggish progression in mathematical competency.

Assessment Gap

Limited tools exist to assess students' mathematical value, identify weaknesses, and support educational development sustainability, hindering efforts to reverse negative performance trends.

OBJECTIVES OF THE STUDY

1. To examine the reliability and validity of the MaV Scale through Exploratory Factor Analysis (EFA).
2. To confirm the reliability and validity of the MaV Scale using Confirmatory Factor Analysis (CFA).
3. To evaluate the usability of the MaV Scale in promoting Mathematics learning in secondary schools for innovative and educational sustainable development.

RESEARCH QUESTIONS

The three objectives that guided this study are as follows:

1. Did the MaV Scale's Exploratory Factor Analysis (EFA) show that all the items in the scale are reliable and valid?
2. Did the MaV Scale's Confirmatory Factor Analysis (CFA) confirm that all the items in the scale are reliable and valid?
3. Is the MaV Scale usable for promoting Mathematics learning in secondary schools for innovative and educational sustainable development?

Exploratory Factor Analysis

Examine reliability and validity of scale items through statistical analysis of underlying factors.

Confirmatory Factor Analysis

Confirm the theoretical factor structure and validate the measurement model.

Usability Assessment

Evaluate practical application for promoting Mathematics learning in secondary schools.

METHODOLOGY

The study is a descriptive survey type because of the survey research qualities of usability and generalisability (Mauldin, 2020), which this study assessed using the MaV Scale for utilisation. All Senior Secondary One (SS I) students in Nigeria were included in the study's target group. SS I was selected as the link between the terminal level basic schools (Junior Secondary III) and the post-basic (Senior Secondary) school levels. Even though the students are already working on the Senior Secondary class syllabus, they are still classified as Junior Secondary III throughout their first term in the SS I class. Six schools were chosen through a multistage sampling technique. First, one of the six geographical zones (South-West) was selected using a simple random sampling technique. Of the six states in the zone, Ondo State and Osun State were chosen at random. From the three senatorial districts in each of the two chosen states, six schools–three private and three public–were chosen at random.

Study Design

- Descriptive survey research
- Target: SS I students in Nigeria
- Focus on usability and generalisability

Sampling Method

Multistage sampling: South-West zone → Ondo & Osun States → 12 schools (6 private, 6 public)

Sample Size

1,300 SS I students randomly selected from the twelve chosen schools

From the twelve chosen schools in Ondo and Osun States, a total of 1,300 SS I students were randomly selected for the study. Usability testing was conducted by administering the MaV Scale Usability Questionnaire to nine research assistants, who then assisted in administering the MaV Scale's 27 validated items to the respondents in the twelve chosen schools of the two states in Nigeria. With a reliability coefficient of $r = 0.738$, the five E's–efficient, effective, engaging, error-tolerant, and simple to learn–describe the complex aspects of usability. RStudio's lavaan package and descriptive statistics in SPSS were adopted for data analysis.

RESULTS OF THE ANALYSES AND DISCUSSION OF FINDINGS

Research Question 1: Did MaVscale's Exploratory Factor Analysis (EFA) show that all the items in the scale are reliable and valid?

Table 1: Item Loadings of the Retained Factors and Corresponding Selected Items

Number	ITEMS	F1	F2	F3	F4
1	BASIC_1		0.540		
2	BASIC_2		0.661		
3	BASIC_3		0.530		
4	BASIC_4		0.350		
5	BASIC_5		0.472		
6	BASIC_6		0.491		
7	BASIC_7		0.627		
8	THINK_5		0.332		
9	REASON_2				0.353
10	REASON_3				0.381
11	REASON_4				0.594
12	EMOTION_2			0.306	
13	PSOLVING_2			0.631	
14	PSOLVING_3			0.491	
15	PSOLVING_5	0.372			
16	PSOLVING_6	0.427			
17	PSOLVING_7	0.512			
18	PSOLVING_8	0.349			
19	PSOLVING_9	0.371			
20	PSOLVING_11	0.580			
21	PSOLVING_12	0.521			
22	TIMEMA_1	0.632			
23	TIMEMA_2	0.529			
24	TIMEMA_3	0.595			
25	TIMEMA_4	0.707			
26	TIMEMA_6	0.522			
27	TIMEMA_7	0.487			

Source: Author

Research Question One was used to discover the number of factors underlying MaVscale from the seven functional skills explored as Mathematics Value. The 'Psych' and 'GPA' packages in RStudio were used for rotation. The results revealed item-level representation between 0.306 and 0.707, which falls within the required benchmark for an item to be valid for use. This established the internal structure of the scale and identified the dimensions associated with the factors of the latent variable (Mathematics Value).

Research Question 2: Did MaVscale's Confirmatory Factor Analysis (CFA) confirm that all the items in the scale are reliable and valid?

Research Question Two was used to further analyse the observed and hypothesised factor structure through Confirmatory Factor Analysis (CFA) to determine the validity and reliability of MaVscale. Ordinal Alpha in RStudio was used for the CFA. The results showed that CFA involved oblique rotation and no cross-loadings (Luhana, 2016). Item-level representation was between 0.578 and 0.780, while R-squared values ranged between 0.334 and 0.596. To answer Research Question Two, the results of the CFA analysis performed using *lavaan* in RStudio to analyse the data collected by MaVscale are presented in Table 2 and Table 3.

Table 2: CFA standardised loadings of MaVscale

	p	b	i	r
b1		0.697		
b2		0.710		
b3		0.752		
b4		0.753		
b5		0.751		
b6		0.766		
b7		0.767		
b8		0.780		
i1			0.765	
i2			0.760	
i3			0.699	
r1				0.738
r2				0.742
r3				0.772
p1	0.721			
p2	0.698			
p3	0.578			
p4	0.723			
p5	0.735			
p6	0.708			
p7	0.722			
p8	0.731			
p9	0.752			
p10	0.721			
p11	0.694			
p12	0.725			
p13	0.726			

Source: Author

Table 3: R Squared inspected

b1	b2	b3	b4	b5	b6	b7	b8	i1	i2	i3
0.485	0.504	0.565	0.567	0.564	0.587	0.589	0.608	0.585	0.578	0.489
r1	r2	r3	p1	p2	p3	p4	p5	p6	p7	p8
0.545	0.551	0.596	0.520	0.487	0.334	0.522	0.540	0.501	0.521	0.535
p9	p10	p11	p12	p13						
0.566	0.520	0.482	0.525	0.527						

Source: Author

27

Total Scale Items

All items retained, with none below the 0.3 cut-off benchmark.

0.95

CFI Index

Comparative Fit Index, indicating excellent model fit.

0.05

RMSEA

Root Mean Square Error of Approximation, showing good fit.

CFA was used in addition to EFA to assess whether the theoretical component structure had empirical validity. Therefore, MaVscale has empirical validity. Since the factor analyses (EFA and CFA) were utilised to evaluate theories of the latent construct–Mathematics Value (Robertson, 2017; DeVellis, 2012)–it implies that MaVscale, with its development theory VSDT, is valid and reliable. None of the items was below the cut-off mark of 0.3. Therefore, none of the 27 items was discarded, as none of their indices fell below the benchmark (cut-off = 0.3). Not a single item loaded incorrectly.

The CFA results confirmed that every item loaded on the same factors as in the Exploratory Factor Analysis (EFA). Additionally, the CFA model-fit summary analysis demonstrated that MaVscale is fit based on the fit indices, which include the following: Standardised Root Mean Square Residual (SRMR) = 0.04 (close to zero), Tucker-Lewis Index (TLI) = 0.94 (greater than 0.9), Goodness-of-Fit Index (GFI) = 0.91, Adjusted Goodness-of-Fit Index (AGFI) = 0.89, Normed Fit Index (NFI) = 0.92, Comparative Fit Index (CFI) = 0.95, and Root Mean Square Error of Approximation (RMSEA) = 0.05.

Research Question 3: Is MaVscale usable to promote mathematics learning in secondary schools for innovative and educational sustainable development?

The data were collected using the MaVscale Usability Questionnaire. The results of the analysis are presented in Table 4.

Table 4 shows the results of the data collected using the five-item usability questionnaire.

Table 4: Results of the data collected by the Usability Questionnaire

Items	MaV Scale is not a waste of time.		MaV Scale is a means to influence my knowledge of Mathematics value.		MaV Scale is engaging.		MaV SCale is error tolerance.		MaV Scale is easy to learn	
	Freq	%	Freq	%	Freq	%	Freq	%	Freq	%
Strongly Disagree	1	0.8	-	-	-	-	-	-	3	2.5
Disagree	7	5.8	5	4.2	5	4.2	3	4.2	9	7.5
Neutral	5	4.2	5	4.2	4	3.3	3	4.2	17	14.2
Agree	61	50.8	51	42.5	75	62.5	55	45.8	60	50.0
Strongly Agree	46	38.3	59	49.5	36	30.0	59	49.2	31	25.8
Total	120	100.	120	100.	120	100.	120	100.	120	100

Source: Author

DISCUSSION

Research Question One was used to discover the number of factors underlying MaVscale from the seven functional skills explored as mathematics value. 'Psych' and 'GPA' rotation in RStudio packages were used. The results in Table 1 revealed the item-level representation between 0.306 and 0.707, which falls within the required benchmark for an item to be valid for usage. This established the internal structure of the scale and identified the dimensions associated with the factors of the latent variable (Mathematics Value).

Research Question Two was used to further analyse the observed and hypothesised factor structure through Confirmatory Factor Analysis (CFA) to determine how valid and reliable MaVscale is. Ordinal Alpha in RStudio was used for the CFA. The results in Table 2 and Table 3 showed that CFA also assumed oblique rotation and no cross-loadings (Luhana, 2016). The item-level representation was between 0.578 and 0.780 (Table 2), while in Table 3 it was between 0.334 and 0.596. CFA was used in addition to EFA to assess whether the theoretical component structure had empirical validity. Therefore, MaVscale has empirical validity. Since the Factor Analyses (EFA and CFA) were utilised to evaluate theories of the latent construct–Mathematics Value (Robertson, 2017; DeVellis, 2012)–it implies that MaVscale, with its development theory VSDT, is valid and reliable.

None of the items were below the cut-off mark of 0.3. Therefore, none of the 27 items were discarded, as none of their indices fell below the benchmark (cut-off = 0.3). Not a single item loaded incorrectly. The CFA results confirmed that every item loaded on the same factors as in the Exploratory Factor Analysis (EFA) in Table 1. Additionally, the CFA model-fit summary analysis demonstrated that MaVscale is fit based on the fit indices, which include the following: Standardised Root Mean Square Residual (SRMR) = 0.04 (close to zero), Tucker-Lewis Index (TLI) = 0.94 (greater than 0.9), Goodness-of-Fit Index (GFI) = 0.91, Adjusted Goodness-of-Fit Index (AGFI) = 0.89, Normed Fit Index (NFI) = 0.92, Comparative Fit Index (CFI) = 0.95, and Root Mean Square Error of Approximation (RMSEA) = 0.05. Therefore, the model-fit study showed that MaVscale usability met the validity requirements. As a result, MaVscale is a very useful tool for assessing mathematical value.

Research Question Three was administered to the research assistants as the primary method for collecting consequential validity. Descriptive statistics in SPSS were used to analyse the data collected. The results from the study in Table 4 confirmed that MaVscale met the condition for robust scale development according to Lamm et al. (2020), which consists of five areas for validation: content, response process, internal structure, external structure, and consequential.

SUSTAINABILITY CONNECTION: Mathematics Value and SDG Achievement

Figure 3: Mathematics education and sustainable development connection in Africa.

Mathematical competency is fundamental to innovation, economic development, and evidence-based decision-making required for sustainable societies. The ability to understand and apply mathematical principles directly supports the achievement of various Sustainable Development Goals (SDGs) by enabling critical thinking, problem-solving, and data analysis in areas such as climate action, economic growth, and quality education (Figure 3).

Research consistently demonstrates a strong connection between mathematics education and national development. Studies show that students' value beliefs significantly predict their mathematics performance and future STEM engagement. Furthermore, countries with stronger mathematics education systems tend to exhibit higher rates of technological innovation and economic growth. Strong mathematical problem-solving abilities, as measured by tools like MaVscale, prepare students for technical and scientific careers that drive innovation, directly contributing to sustainable development (Carey et al., 2017). The reasoning and intelligence skills dimensions assessed by MaVscale also support the development of self-regulated learning, which is crucial for lifelong learning and adaptability in a changing economy (Mejeh & Held, 2022).

MaVscale Skills and Sustainable Societies

MaVscale's mathematical value skills are integral to building sustainable societies:

- **Mathematics Problem-Solving Skills (MPS):** Essential for addressing complex global challenges, including optimising resource allocation, developing sustainable technologies, and efficient urban planning.
- **Mathematics Basic Skills (MBS):** Provide foundational literacy for an informed citizenry, enabling sound financial decisions, understanding health data, and engaging with scientific information.
- **Mathematics Intelligent Skills (MIS):** Foster critical thinking and analytical capabilities, crucial for evidence-based policy-making, risk assessment, and strategic environmental and social governance.
- **Mathematics Reasoning Skills (MRS):** Enable logical inference and valid argument construction, vital for scientific research, engineering, and ethical considerations in technological advancements.

The Mathematics Literacy Crisis in Africa

Despite mathematics' clear importance, a significant challenge persists in Africa. Over 60% of children and young people do not meet minimum mathematics proficiency (UNESCO data; Africa Sustainable Development Report, 2022). This crisis severely hampers the continent's sustainable development goals by impeding innovation, limiting economic diversification, and hindering evidence-based decision-making for societal and environmental issues.

Pathway to Sustainable Development

The connection between valuing mathematics and achieving sustainable development progresses as follows:

01

Mathematics Value Orientation

Students informed about mathematics' value develop a positive orientation, leading to sustained engagement.

02

Improved Learning Outcomes

Enhanced value orientation motivates better mathematical performance, deeper skill acquisition, and increased STEM participation.

03

Sustainable Development Achievements

A mathematically proficient populace drives innovation, economic growth, evidence-based solutions to global challenges, and overall societal well-being.

CONCLUSION

The primary findings of this study demonstrate the integral role of mathematical proficiency in sustainable development:

01

Value-Orientation Connection

MaVscale posits that informing students about mathematics' value cultivates a positive orientation, driving sustained engagement and achievement (Abebe, 2025). This sustained engagement is vital for students to pursue STEM fields and contribute to national development goals.

02

Motivational Impact

Encouraging learners to discover mathematics' value motivates skill acquisition (Isaac-Oloniyo, 2023), improving achievement and performance in other subjects, and preparing them for career success and economic development (Brezavšček et al., 2020).

03

Skill Development & Innovation

MaVscale-measured mathematical problem-solving skills prepare students for technical and scientific careers, driving innovation and sustainable development (Carey et al., 2017). Its reasoning and intelligence skills dimensions also foster self-regulated learning, essential for lifelong adaptability (Mejeh & Held, 2022).

04

Usability Confirmation

MaVscale met usability requirements, demonstrating efficacy, efficiency, user-friendliness, engagement, and error tolerance. It was deemed a very good, user-friendly tool for assessing students' mathematics proficiency.

05

Educational Application

All 27 items were confirmed for use, promoting innovative and sustainable educational development in secondary schools.

The administrators concluded that MaVscale is a reliable tool for gauging students' proficiency in mathematics. Its 27 confirmed items can foster essential skills for individual growth and societal progress, promoting innovative and sustainable educational development in secondary schools.

RECOMMENDATIONS

The following recommendations are presented based on the study's findings and implications:

1. MaVscale should be used by teachers for both formative and summative evaluation, by administering it to learners during teaching processes and at any terminal stage of their learning for promotion, in order to measure learners' mathematical capability.
2. Teachers should use the results of the MaVscale administration to counsel and guide learners appropriately and encouragingly, for better performance in mathematics, thereby eradicating ignorance of mathematics' valuable skills.
3. Mathematics Value Orientation must be supported and promoted by all relevant stakeholders–teachers, school counsellors, learners, parents, and government–in order to build learners' confidence and give them greater hope for future success.

Teacher Implementation

Use MaVscale for formative and summative evaluation during teaching processes and at terminal learning stages.

Student Guidance

Utilise MaVscale results for counselling and encouraging learners to improve mathematics performance.

Stakeholder Support

Promote Mathematics Value Orientation through collaboration between teachers, counsellors, parents, and government.

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Not Applicable

CONFLICTS OF INTEREST

The author declares no conflict of interest.

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REFERENCES

Adetula, O. (2024, August 20). *Analysis of WASSCE results from 2020-2024*. uLesson Blog. **https://ulesson.com/blog/analysis-of-wassce-results-from-2020-2024/**

Boaler, J. (2012). *Mathematical mindsets: Unleashing students' potential through creative math, inspiring messages and innovative teaching*. Jossey-Bass.

Brennan, R. L. (2001). *Generalisability theory*. Springer.

CareerBuilder. (2017, October 24). *What are problem-solving skills and why are they important?* CareerBuilder. **https://www.careerbuilder.com/advice/what-are-problem-solving-skills-and-why-are-they-important**

Cazañas-Gordón, A., Miguel, A., & Mora, E. S. (2017). Estimating sample size for usability testing. *Investigaciones en Educación Médica*, *8*(1), 172-185.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, *16*(3), 297-334. **https://doi.org/10.1007/BF02310555**

DeVellis, R. F. (2012). *Scale development: Theory and application* (3rd ed.). SAGE Publications Inc.

DeVellis, R. F. (2017). *Scale development: Theory and applications* (4th ed.). Sage Publications.

Eccles, J. S., & Wigfield, A. (2002). Motivational beliefs, values and goals. *Annual Review of Psychology*, *53*, 109-132. **https://doi.org/10.1146/annurev.53.100901.135153">https://doi.org/10.1146/annurev.psych.53.100901.135153**

Fogarty, M. (1996, July). *A history of value theory*. Trinity College Dublin, Department of Economics.

Gallagher, T. (2001). The value orientation method: A tool to help understand cultural differences. *Journal of Extension*, *39*(6).

Hitlin, S., & Piliavin, J. A. (2004). Values: Reviving a dormant concept. *Annual Review of Sociology*, *30*, 359-393. **https://doi.org/10.1146/annurev.soc.30.012703.110640**

Isaac-Oloniyo, F. O. (2023). *Development of mathematics value scale and its predictive estimate on mathematics achievement among Senior Secondary 1 students in Nigeria* [Unpublished doctoral dissertation]. Ekiti State University.

Isaac-Oloniyo, F., Okpala, P. N., & Adeleke, J. O. (2021). Validation of value scale development (VSD) theory for student mathematics value (SMaV) scale development. *Ikere Journal of Humanities (IK-JOH)*, *2*(2), 63-67.

Lamm, K. W., Lamm, A. J., & Edgar, D. (2020). Scale development and validation: Methodology and recommendations. *Journal of International Agricultural and Extension Education*, *27*(2), 24-35. https://doi.org/10.5191/jiaee.2020.27224

Martinez, M. (2010). *Learning orientation overview* [Unpublished manuscript].

Mauldin, R. L. (2020). *Foundations of social work research*. UTA Pressbooks. https://uta.pressbooks.pub/foundationsofsocialworkresearch/chapter/7-2-assessing-survey-research/

Maze. (n.d.). *Usability testing*. Maze Guides. https://maze.co/guides/usability-testing/

MeasuringU. (2022). *Problem-impact*. https://measuringu.com/product/problemimpact

Offiong, A. V. (2009, August 2). *Why is mathematics a dreaded subject?* Daily Trust. https://dailytrust.com/why-is-mathematics-a-dreaded-subject/

Onwuka, E. (2024, August 12). WAEC releases results for nearly 1.7 million students, withholds 215,267 results. *The West African Pilot News*. https://www.westafricanpilotnews.com/2024/08/12/waec-releases-results-for-nearly-1-7-million-students-withholds-215267-results

Richardson, F. C., & Suinn, R. M. (1972). The Mathematics Anxiety Rating Scale. *Journal of Counselling Psychology*, *19*(6), 551-554.

Salau, G. (2025, April 25). 54.3% of Lagos students failed WASSCE in 2024. *The Guardian Nigeria*. https://guardian.ng/news/54-3-of-lagos-students-failed-wassce-in-2024/

Speicher, M., Both, A., & Gaedke, M. (2015). Inuit: The interface usability instrument. In A. Marcus (Ed.), *Design, user experience, and usability: Design discourse* (Vol. 9186, pp. 418-440). Springer.

Testbook. (n.d.). *What is mathematics?* https://testbook.com/maths/what-is-mathematics

TheTopTens. (n.d.). *Worst school subjects*. https://www.thetoptens.com/subjects/worst-school-subjects/

Tomaszewski, M. (2022, November 28). *What are hard skills? Definition and examples for every CV*. Zety. https://zety.com/blog/hard-skills

Transum. (2020). *Thinking skills and evaluation skills*. https://www.transum.org/Software/Thinking_Skills/

Trustradio. (n.d.). *Why is mathematics a dreaded subject?* https://trustradio.com.ng/#gsc.tab=0

Utibe, U. J., & Agwagah, U. N. (2015). A decade of candidates' performances in NECO-SSCE Mathematics in Nigeria. *Journal of Education and Practice*, *6*(25), 25-29.

Zero to Three. (2021). *Help your child develop early math skills*. **https://www.zerotothree.org/resources/180-help-your-child-develop-early-math-skills/**

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