

The Identification and Utilization of Maslow's Hierarchy of Needs in Ghana's Senior High Mathematics Curriculum

Emmanuel Oppong-Gyebi¹, Belbase Shashidar², Kwadwo Amo-Asante¹

¹Akenten Appiah Menka University of Skills Training and Entrepreneurial Development, Kumasi, Ghana

²Department of Mathematics, Troy University, Troy, Alabama, USA

Article Info

Article history:

Received 2024-04-19

Revised 2024-06-15

Accepted 2024-06-23

Keywords:

Aesthetic Needs

Cognitive Needs

Maslow's Hierarchy of Needs

Mathematics Curriculum

Transcendence

ABSTRACT

This study identifies all observable action verbs in the Senior High School core mathematics curriculum and links them to Maslow's Hierarchy of Needs. All the 217 identified action verbs were further grouped in a matrix form in the order of Maslow's hierarchy of needs against the major headings as stated above in the syllabus. The study collated the frequencies and percentages of the action verbs in a matrix form using Microsoft Office Excel 2019. The study revealed that each of the verbs represents the key profile component of each objective. The study revealed that teachers should evaluate students appropriately in their knowledge and understanding, invention and creativity, analysis, and application, as these represent the growing needs in Maslow's Hierarchy of Needs. It also revealed how the curriculum designers intended for students to fulfill the majority of their needs in the teaching and learning column of Maslow's hierarchy matrix through these activities. To accomplish the predetermined goal, the study advises teachers to employ these action verbs as they arise in the curriculum's objective for the subject being studied. Future studies should look into whether the mathematics curriculum's application of 21st-century skills aligns with the needs hierarchy's stages.

This is an open-access article under the [CC BY-SA](https://creativecommons.org/licenses/by-sa/4.0/) license.



Corresponding Author:

Emmanuel Oppong-Gyebi

Department of Mathematics Education, Akenten Appiah Menka University of Skills Training and

Entrepreneurial Development, Kumasi, Ghana

Email: eopponggyebi@gmail.com

1. INTRODUCTION

The curriculum of every country or state outlines its broad vision for students' effective acquisition of knowledge, skills, and values through a well-structured curriculum that is officially designated in the operation of any school within its borders. This well-thought-out curriculum is subjected to several changes to create a standard curriculum [1]. These include the necessary educational models and curricular characteristics, providing teachers, students, educational authorities, and key stakeholders with a visible plan and

framework for delivering quality education [2]. Teachers are identified as the pivot in establishing, implementing, testing, and modifying the curriculum, outlining learning outcomes, standards, and essential competencies that students must exhibit before progressing to the next level [3]. Student needs must be satisfied in this process, and the more they can achieve these requirements, the more students will participate in class [2].

The mathematics curriculum is required to meet the majority of students' demands for teaching and learning to take place in the classroom. It necessitates prioritizing these requirements by Maslow's Hierarchy of Needs, a motivational theory that consists of an eight-tier view of human needs, generally shown as hierarchical tiers within a pyramid [4]. It requires students to first attend to the needs of those below in the hierarchy before they can attend to those higher ones [5]. Nevertheless, the question is, are the needs of students in the form of actions factored in the designing of the mathematics curriculum? This has paved the way for research to look into the core mathematics curriculum at senior high school and see how it relates to Maslow's Hierarchy of Needs.

New Mathematics Curriculum in Ghana

There was nothing like an educational system from the onset. However, the sociocultural setting of the respective group of people in the then Gold Coast (now Ghana) had a variety of ethnomathematical tools and concepts [6]. Aside from apprenticeship, the only way for their generations to be educated [7]. Later, in the 16th and 17th centuries, European merchants and Christian missionaries introduced a Western form of education to their mulatto offspring in the castles of the Gold Coast [7], [8]. The mathematics curriculum came to take center stage when the system was delivering education mainly at the primary level with a secular curriculum solely devoted to the teaching of the "three R's," namely, reading, writing, and arithmetic. It allowed the Europeans to bring forth literature and syllabi full of socio-cultural values from the West [6], [9].

While retaining many of the British educational policies not long after independence, the mathematics curriculum simultaneously revolutionized with that of the United States in the 1950s and 1970s as a response to the Sputnik crisis [10]. The new math innovation was implemented through two major curriculum reforms in Ghana. The African Mathematics Programme (AMP) was the first and was established in Africa in 1961 to generate multiple mathematical textbook schemes for all levels of education in the commonwealth countries [10], [11]. The Joint Schools Project (JSP) also followed in 1965 to create mathematics textbooks for all secondary school levels across the country [10]. The Examination Council of West Africa which came into existence in 1967 [10], [12], has been in charge of organizing school certificate examinations on new math activities. The redesigning and transformation of primary school mathematics into a modern syllabus was fully completed in 1971 [11], [13]. The syllabus now classified the practical teaching of numbers as part of the sets and their operations [11]. The educators urge teachers to include students' sociocultural and linguistic backgrounds in their teaching approaches [2].

The 21st century is witnessing a paradigm shift where educators have prioritized training future generations full of knowledgeable individuals who would be abreast of 21st-century skills to enable them to solve practical world problems [15], [16]. However,

Ghana's performance at TIMSS from 2003 to 2011 and many sensitizations from International bodies like American mathematics teachers' educators [14], TIMSS [15], and PISA [16] emphasized the importance of reviewing how mathematics instructions were delivered in the country's pre-tertiary institutions. Out of these and many other reasons, in 2008, through the Educational Act 778 [17], [18], [19], the Anamuah Mensah Committee released a new mathematics curriculum proposal, opening the door for the inclusion of 21st-century skills that also require students to be constructive in their learning [20]. This gave birth to the current mathematics curriculum [21] under study. The ultimate purpose was to maximize students' self-directed learning capacities so that they could gain the mathematical skills, knowledge, attitudes, and values they need to be successful in their chosen occupations and daily lives [22]. Some policies have greatly aided students in concentrating on their academic work and activities.

Notable of them are the 2005 Ghana School Feeding Program (GSFP) [18], [23], [24], and the highly regarded Free SHS (2017-FSHS) that made secondary education accessible to all Ghanaians [25]. Even though there is an ongoing reform to implement the standard-based curriculum from 2025 at all secondary and STEM schools [26], [27]. This will encourage students to use a variety of instructional methods and resources to assist them in developing the mathematical skills that they will need in their everyday lives [28].

Maslow's Hierarchy of Needs

Abraham Maslow, a Brandeis University professor of psychology, is appropriately regarded by Aruma and Hanachor [29] as one of the founding fathers in the field of human psychology and motivation in modern civilization [30]. His mainstream work was initially published in 1943, and a follow-up paper in 1954, both explaining his hierarchy of needs [31]. He eventually expanded it to include his observations of humans' intrinsic desires. His viewpoint stressed how individuals may effectively better themselves in terms of their desires and motivations, and how they can realize their complete capacity.

According to Maslow [32], human needs are organized into hierarchies of ascendancy, and the manifestation of one need is frequently dependent on the fulfillment of a higher-priority need. Deckers [33] interpreted this theory as a rating system that began with society's universal necessities and progressed to many more acquired passions. Although the original study did not provide it in a diagrammatic form [34], [35], [36], Maslow's hierarchy of needs is typically depicted as a pyramid, with the most essential requirements at the bottom and the urge for self-actualization and transcendence at the top [37]. This hierarchy of needs is divided into deficiency and growth needs, with individualism and need prioritizing being two major aspects of the theory [38]. Tulika and Prakash [39] hinted on at a person will fall short in development if these deficiency needs are not met. Notwithstanding this, Noltemeyer et al. [40] indicated a strong correlation between deficiency and growth demands in their findings on 360 students with some economic concerns.

Maslow [32] first developed a five hierarchy of needs, with each stage reliant on the previous stage's fulfillment. [41], [42]. The physiological stage is the hierarchy base, and it includes students' survival needs. Students must have food, water, air, shelter, and a

convenient and comfortable place before they can feel loved or esteemed [43]. Meeting demands make the human body function effectively. Maslow considered physical needs as the most significant, with several other needs assuming a back seat when they were met. Students can now progress to the security and safety of the self-belonging stage after satisfying the physiological stage, which includes the removal of artificial risks, excellent health, a well-planned institution, and a safe learning environment free from natural disasters [41]. Noltemeyer et al. [40] recognized the achievement consequence of their research as safety requirements (health service accessibility). Zheng et al. [44] tried linking the safety needs to emotions and observed the causes of fear to be the baseline assessment that is tied to an individual's safety, but the secondary adaptation process causes rage which again is associated with dealing with dangerous conditions.

The next stage in the hierarchy is the love stage. Interpersonal relationship belonging, which includes the presence of friends, family, and a student's affection, meets their love needs [32], [41], [45], [46]. The stage of love, according to Maslow [32], should be showing love to others but not only receiving it from them. The esteem stage is the fourth stage in the hierarchy. At this moment, a student expects to command self-respect and also respect others, and the fulfillment of these leads to increased ego and self-efficacy [41], [47]. They should also be recognized for their accomplishments. Self-actualization, the ultimate level, is a very metaphysical stage because it might signify a variety of meanings [31], [41]. It's a stage of self-actualization where you can be the best that you're capable of becoming. For example, students want to get the best grade on mathematics tests or be the best athlete, dancer, DJ, or religious leader. Mittelman's [48] discussion on how people become self-actualized, proposed that the individuals Maslow [49] highlighted were not distinguished from others not by their self-actualizing, but rather by their openness.

Maslow's [32], [46] five-stage model was modified in his 1964 book "Religions, Values, and Peak Experiences" which added aesthetic cognitive, and subsequently transcendental needs [49]. Modifications to the original five-stage model, a seven-stage model, and consequently, an eight-stage model, both established throughout his excellent works in the 1960s and 1970s, are noted. He pushed Self-Actualization to the seventh and introduced Cognitive Needs as the number five [49].

The cognitive needs are the knowledge and understanding that students have the desire to explore, go on field trips, and need meaning and predictability [50]. Aesthetic needs, which implies showing appreciation and searching for beauty, balance, and form, to mention but a few, and transcendence, as sixth and eighth, respectively, in the hierarchy of needs, as shown in Figure 1 below. Ventegodt et al. [51] stressed the need to help others to acknowledge what they possess or need.

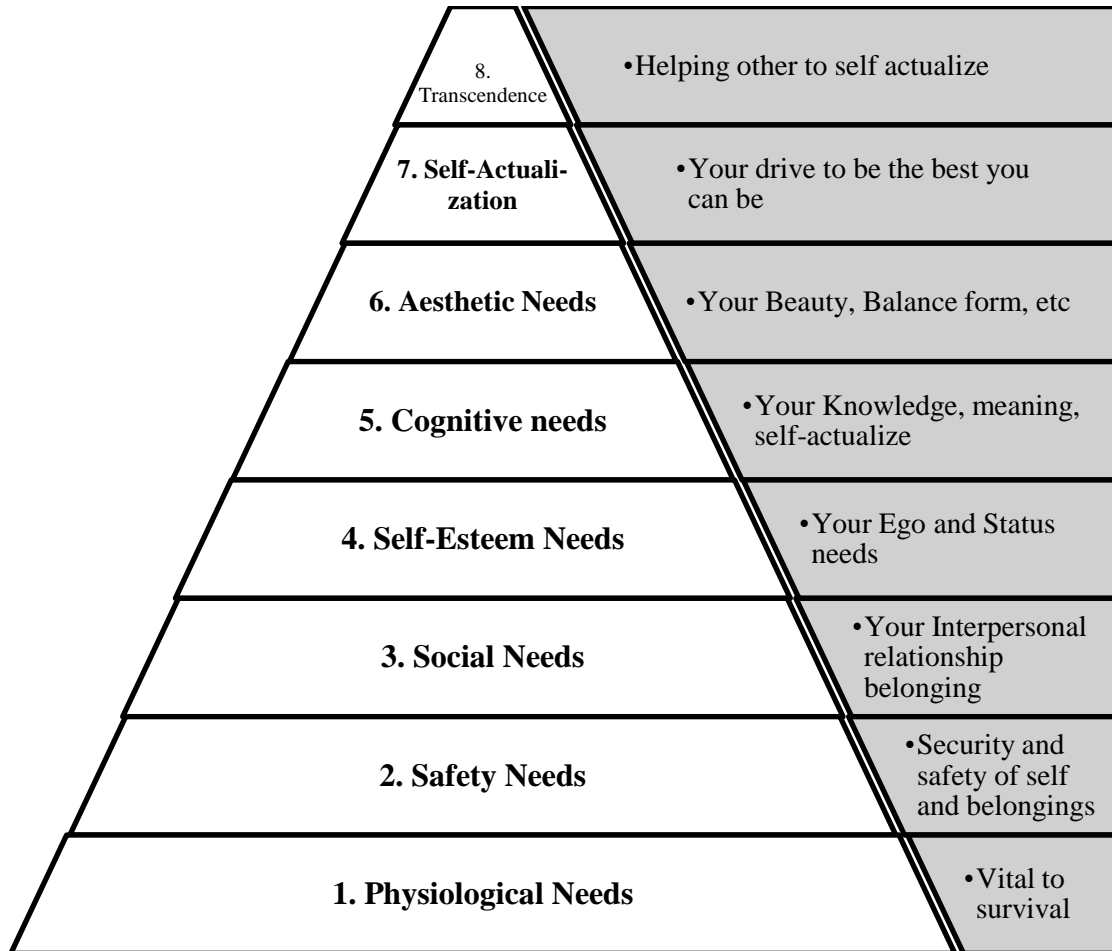


Figure 1. Maslow Hierarchy of Needs. Adopted from Ward and Lasen [52]

Some researchers [53], [54], [55] have criticized Maslow’s hierarchy of needs as being sparse and questioned if there exists any rigid order of needs for every individual to accomplish although they acknowledged that human beings do have some needs to be fulfilled. Wahba and Bridwell’s [55] discussion of Maslow’s works in 1943, 1954, and 1970 unconditionally adopted papers claimed a lack of scientific proof after 10 analytical factors and three evaluation studies show a limited explanation for Maslow’s Needs Hierarchy. However, linking Maslow’s hierarchy directly to mathematics education may vary, these points illustrate how Maslow’s ideas contribute to a more holistic and effective educational approach, including in the teaching and learning of mathematics but not stick to a rigid laid down approaches to achieve students’ hierarchy of needs.

Connection between Hierarchy of Needs and Mathematics Curriculum

The hierarchy of needs must be incorporated into the curriculum so that it can nurture students in stages until they reach a point where deciding on practical life experiences and job choices becomes simple. Bridgman et al. [34] highlight how a fundamental method of researching and inspiring students throughout the educational process emerges in a hierarchy that individuals strive to address in a precise way. The curriculum developers divide the core mathematics syllabus into years and then into units [56]. They are then organized into subsequent units to fulfill the demands of classroom

instruction [56]. The curriculum topics are arranged based on the hierarchical order of the needs of the students[57]. For instance, teaching real number systems before sets and operations of sets allows the learners to come up with a set of numbers when being described and not listed. Hassi et al. [58] work on the teaching of foundation mathematics among older adults who had no mathematics background revealed their lack of knowledge in other abstract mathematics. Hassi and her friends did not begin problem-solving or abstract math from the beginning, indicating that an ordered and planned curriculum was being followed to teach adults from the basics to the advanced. It's among the first and perhaps most powerful motivational education models encountered by students [34], and experts believe it should be incorporated into the development of the mathematics curriculum. Many educators emphasize the importance of this hierarchy of needs in educational contexts and among students [59], [60] - [64]. Nevertheless, few, if any, attempt to identify its presence in the curriculum. It is reasonable to connect Maslow's Hierarchy of Needs to Ghana's senior high school mathematics curriculum to determine its presence.

The convincing argument for such a mathematics curriculum is to achieve a single important aim: to empower every young Ghanaian to gain the intellectual capabilities, ideas, perspectives, and ethics needed to be successful in their respective future professions and personal lives [21]. This shows a clear connection between Maslow's Hierarchy of Needs and the curriculum. The foundation is built on the previous knowledge and competencies gained at the Junior High School level and is expected to reach its peak at the SHS level. At the Secondary level, the curriculum expects the student to nurture the necessary mathematical capabilities to utilize his/her skills to resolve real issues and be well keen to undertake additional research and related professions in mathematics and other related fields.

The hierarchy provides a progressive opportunity and the need for all students to learn mathematics up to the stage where it would guide them to select their future careers [38]. However, we should trade cautiously when it comes to the language and the mode of carrying out the outlined task. Tambyehik and Meerah [65] did a study regarding skill issues in mathematics and discovered a lack of reading comprehension such as creating links, controlling knowledge, articulating mathematical statements, and deciding formulas to be employed were found among students. However, Morin and Franks [66] highlighted how instructional language communication might cause students to have learning deficiencies, making collaboration in teaching and learning challenges.

The study's main objective addressed how Maslow's hierarchy of needs connects to the Ghanaian SHS core mathematics curriculum. Specifically, addressing the following objectives. To link all action verbs within the curriculum to each stage of Maslow's hierarchy of needs and to analyze their relevance at each stage of the hierarchy in the study of mathematics. The following questions helped to achieve the above objectives:

1. Does Maslow's Hierarchy of Needs play a role in the development of the SHS core mathematics curriculum?
 2. How do the stages of Maslow's Hierarchy of Needs appear in the SHS Core Mathematics Syllabus' content, teaching and learning outcomes, and assessment?
-

Do the selected action verbs in the selected stages play a significant role in the teaching and learning of mathematics?

2. METHOD

The study adopted a non-experimental survey on the Ghanaian senior high school core mathematics curriculum [21] to list out all the action verbs and group them according to the Maslow hierarchy of needs. The mathematics curriculum layout, which is in three-year divisions, is not consistent from year to year. However, it prepares students to write a final West Africa Senior Secondary Certificate Examination (WASSCE) by the end of the third year. Hence, there is a need to consider all the three-year SHS core mathematics syllabus for this study. Secondary data was solely used for this study. In the process of the matrix, the hierarchy of needs is on the row side while the objectives, content, teaching and learning activities, and assessment in the syllabus appear on the columns. Sorting the action verbs into the Matrix table (Table 1), they are further grouped in the order of Maslow's hierarchy of needs against the major headings as stated above in the syllabus. The matrix was given to two reviewers to test for their reliability by critically validating these action verbs to confirm if they fit in their selected hierarchy of needs. After that, a quantitative collation of the frequencies and percentages of the action verbs in a matrix form followed so that they could be statistically analyzed using Microsoft Office Excel 2019 (Table 2).

3. RESULTS AND DISCUSSION

3.1. Sorting of Action Verbs

In all, two hundred and seventeen action verbs were obtained from the SHS syllabus as shown in Table 1. The fundamental action verbs (such as add, subtract, divide, multiply, read, write, approximate, order, round, estimate, measure, and record) are considered vital for mathematical learning to proceed and therefore are classified as physiological needs. Students will reach a safe zone if they are successfully able to (*simplify, factorize, solve, calculate, convert, rationalize, inverse, depreciate, increase, or decrease*) any given mathematics problem. If they can (*relate, distinguish, compare, imply, differentiate, equate, correspond, exchange, map, sort, or intersect*) well, it shows a good relationship between the two given mathematical sets, expressions, or statements. Again, if the student is also able to either present or represent from one form to another or can either respond to or be involved in an activity, it shows the social connection of the students as well. The student's ego and status can also be exhibited if they can involve themselves with the action verbs like *select, use, determine, describe, find, identify, state, change, list, put, verify, locate, change, check, derive, and show*.

The cognitive needs always reflect knowledge work in the field of Maslow's hierarchy of needs with keywords such as compute, recall, define, reflect, revise, and realize. They depict the knowledge and meaning of self-actualization. The aesthetic needs, that is the need to discover beauty and creativity in mathematics, come to bear when using verbs like *perform, develop, create, form, practice, classify, draw, construct, review, shade, discover, fold, plot, make, translate, and expand*. Self-actualization showcases the best that a student can be by having the ability to *interpret, analyze, investigate, undertake,*

express, explain, deduce, verify, establish, study, or examine a given mathematical problem. When students reach the peak (transcendence) of Maslow's hierarchy of needs, they certainly become abreast with whatever their teacher teaches them from the basic to the final stage and can *apply, organize, discuss, share, assist, encourage, illustrate, emphasize, or share* with others.

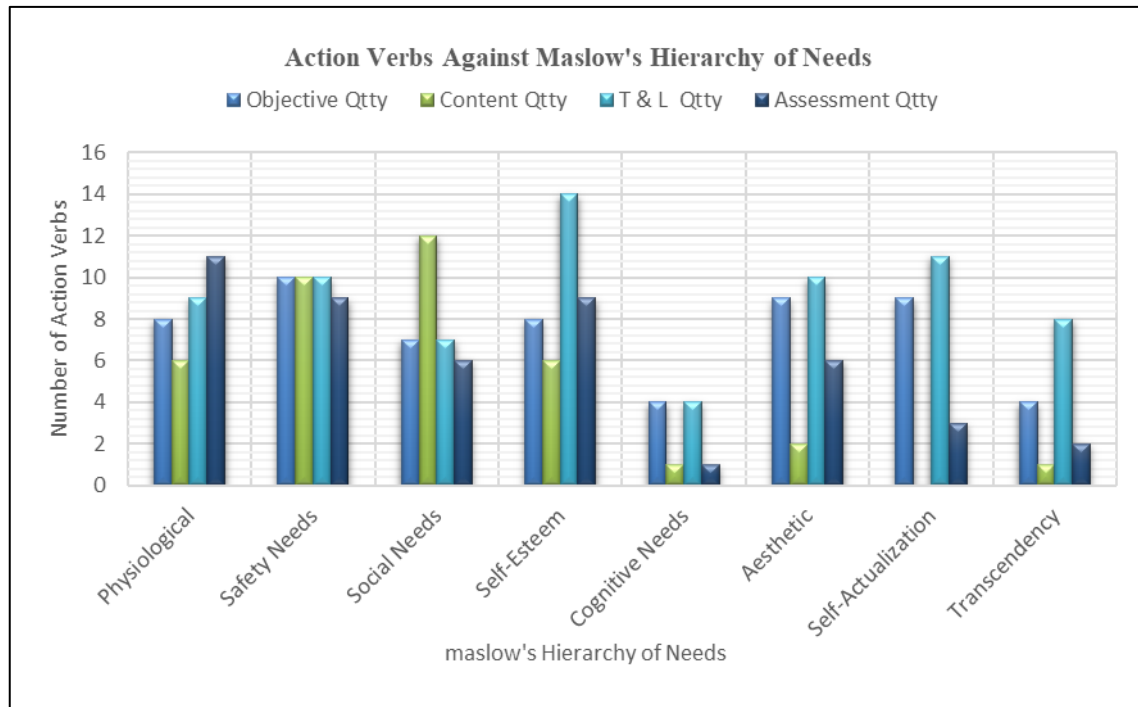


Figure 2. Action Verbs against Maslow's Hierarchy of Needs

Table 1: Matrix Presentation of Key Action Verbs in the SHS Mathematics Curriculum

Hierarchy of Needs	Objective		Content		Teaching and Learning Outcome		Assessment		Total
Physiological	write	Approximate	add		add	Estimate	write	multiply	
	subtract	Order	Subtract		subtract	Measure	copy	estimate	
	add		multiply		multiply	Approximate	Order	read	
	Read		Order		read		round	record	
	multiply		Approximate		write		Approximate	Subtract	
	Divide		Round		Order		Add		
		8		6		9		11	34
Safety Needs	Inverse	Depreciate	Simplify	Increase	Decrease	Inverse	Solve	Increase	
	Simplify	Increase	Rationalize	Decrease	Simplify	Depreciate	Place	Decrease	
	Rationalize	Decrease	Solve	Inverse	Rationalize	Increase	Simplify	Inverse	
	Convert	Calculate	Convert	Calculate	Solve	Convert	Factorize	Calculate	
	Factorize	Solve	Depreciate	Operate	Factorize	Calculate	Convert		
		10		10		10		9	39
Social Needs	Present	Distinguish	Compare	Distribute	Distinguish	Sort	Imply	Relate	
	Respond		Differentiate	Present	Compare		Intersect		
	Represent		Equate	Exchange	Relate		Compare		
	Relate		Relate	Compare	Represent		Represent		
	Imply		Correspond	Imply	Map		Distinguish		
	Compare		Represent	Imply	Involve				
		7		12		7		6	32
Self-Esteem Needs	Select	State	Find		Describe	Use	Find	List	
	Use		Describe		Determine	Derive	Verify	Determine	
	Determine		Use		Put	Find	Use		
	Describe		Change		Verify	State	Describe		
	Find		Reverse		List	Check	Identify		
	Identify		Identify		Identify	Put	State		
	Change				Change	Locate	Show		
		8		6		14		9	37

Table 1. Matrix Presentation of Key Action Verbs in the SHS Mathematics Curriculum (Continued)

Hierarchy of Needs	Objective		Content		Teaching and Learning Outcome		Assessment		Total
Cognitive Needs	Compute	Recognize	Reflect		Revise	Compute	Define		
	Define	Recall			Recognize	Realize			
	4		1		4		1		10
Aesthetic Needs	Perform	Construct	Construct		Review	Fold	Draw	Make	
	Develop	Translate	Draw		Shade	Perform	Construct		
	Create	Classify			Draw	Plot	Shade		
	Form	Practice			Develop	Construct	Expand		
	Draw				Discover	Form	Translate		
	9		2		10		6		27
Self-Actualization Needs	Interpret	Verify			Deduce	Prepare	Explain		
	Analyze	Establish			Express	Examine	Express		
	Investigate	Explain			Verify	Explain	Interpret		
	Undertake				Investigate	Study			
	Express				Interpret	Establish			
Deduce				Practice					
	9		0		11		3		23
Transcendence Needs	Apply		Apply		Guide	Discuss	Apply		
	Organize				Assist	Illustrate	Illustrate		
	Discuss				Encourage	Share			
	Share				Apply	Emphasize			
	4		1		8		2		15
Overall Total	55		37		69		46		217

3.2. Matrix Analysis

After sorting them from a mathematical point of view, the majority of them (33.6%) came from the teaching and learning activities, with the least appearing in the content column of the syllabus. It is not surprising for the teaching and learning activities to have the highest action verbs as it is the column that shows maximum student participation in the lesson. "Assessment" fell behind "Objective" by only twelve verbal actions but outweighed "Content" by nine action verbs.

Among the hierarchy of needs rows in the matrix table, as many as 17.1% of the verbs were assigned to self-esteem needs, closely trailing behind safety needs (18.0%), which recorded the highest. It was interesting to note that the transcendence needs (6.9%) nearly recorded the least verbs. However, they managed to outweigh cognitive needs (4.6%) by five action verbs (See Figure 2).

The self-esteem action verbs in the teaching and learning activities recorded the highest verbs (14) in the matrix boxes. Social needs verbs (5.5%) within the content column were the second highest, closely and jointly followed by self-actualization verbs that appeared in teaching and learning activities and physiological verbs that appeared in assessment (5.1%) (See Figure 2). No verb was recorded for self-actualization verbs within the content column. However, transcendence and cognitive verbs within the content and cognitive verbs within the assessment managed to generate only a verb in their respective matrices.

The objective, which recorded the second-highest number of action verbs, saw the verbs above-average distributed among six (safety (4.6%), aesthetic (4.1%), self-actualization (4.1%), self-esteem (3.7%), and physiological (3.7%)) out of the eight hierarchy of needs. Falling below the average (3.4%) of each of the hierarchy of needs within the objective column are the social (3.2%), transcendence (1.8%), and cognitive verbs (1.8%).

On the other hand, the majority of the action verbs within the content were centered on the first four of the hierarchy of needs (physiological (2.8), safety (4.6%), social (5.5%), and self-esteem (2.8%)). It swiftly declines (cognitive, aesthetic, self-actualization, and transcendence, i.e., 0.5%, 0.9%, 0.0%, and 0.5% respectively) as the hierarchy progresses to the peak. Although the teaching and learning column has the highest average of 4.2%, as many as four of the hierarchy of needs (physiological (4.1%), social (3.1%), cognitive (1.8%), and transcendence (3.7%)) fell below the average. Even though assessment has the third-highest number of verbs (47), four of the hierarchy of needs (cognitive, self-actualization, and transcendence) have verbs that fall below the average of 2.7 percent.

Table 2. Quantitative Presentation of Key Action Verbs in the SHS Mathematics Curriculum

Hierarchy of Needs	Objective		Content		T & L		Assessment		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Physiological	8	3.7%	6	2.8%	9	4.1%	11	5.1%	34	15.7%
Safety Needs	10	4.6%	10	4.6%	10	4.6%	9	4.1%	39	18.0%
Social Needs	7	3.2%	12	5.5%	7	3.2%	6	2.8%	32	14.7%
Self-Esteem	8	3.7%	6	2.8%	14	6.5%	9	4.1%	37	17.1%
Cognitive	4	1.8%	1	0.5%	4	1.8%	1	0.5%	10	4.6%
Aesthetic	9	4.1%	2	0.9%	10	4.6%	6	2.8%	27	12.4%
Self-Actualization	9	4.1%	0	0.0%	11	5.1%	3	1.4%	23	10.6%
Transcendence	4	1.8%	1	0.5%	8	3.7%	2	0.9%	15	6.9%
Total	59	27.2%	38	17.5%	73	33.6%	47	21.7%	217	100.0%
Average Number of Verbs	7.4	3.4%	4.8	2.2%	9.1	4.2%	5.9	2.7%	27.1	12.5%

4. DISCUSSION

During the sorting process, the study discovered how each action verb represents the core profile aspect of each objective. The verbs assist the teacher in determining the action verbs' relevance and profile dimension about the objective of the topic they are teaching. To avoid the findings of Morin and Franks [66] on the use of language causing learning deficiencies to impede the curriculum hierarchy progress, these verbs should be adequately articulate and self-explanatory for students to complete any given assignment.

Deckers' [33] interpretation of the hierarchy of needs begins with society's universal necessities and moves to the more required passions, supporting Maslow's [32] classification, which significantly connects to the mathematics curriculum by addressing the most essential physiological requirements. It is no surprise that the study reveals some fundamental action verbs such as write, add, subtract, multiply, divide, approximate, order, and read to be the initial needs for mathematics studies. This supports Hassi et al.'s [58] work which commenced with the teaching of old adults from fundamental mathematics. Uysal et al [31] and Tambyehik and Meerah [65] on the other side also support the neediness of these assigned verbs as the most significant as affirmed by Maslow to pave the way for other necessary actions to follow suit in the mathematics curriculum.

Learning mathematics at times is quite challenging. Moreover, if students can come up with the correct answer, they will feel safe in the study of mathematics. Relating well using mathematical statements, expressions, equations, or inequalities using the social needs verbs similarly depicts the interpersonal relationship belongings as stated by Fisher and Royster [41] and Maslow [32], [46]. It may even offer students positive connections with family, friends, staff, social groups, religious groups, dormitory mates, and above all, the affection needed to face the love and beauty of mathematics in the hierarchical stages ahead. In an attempt to solve a mathematical problem, students embed in their self-esteem the need for passion, boldness, and both self-respect and respect for others, which is

consistent with Fisher and Royster [41] and Uysal et al [31]. These two things are related and crucial, therefore self-esteem action verbs and safety needs are the two elements that appear the most.

The curriculum developers supporting Kolstad et al. [56] expect students to acquire the majority of their needs through these activities in the teaching and learning column in the order of Maslow's hierarchy. Because the content section mostly illustrates mathematical principles and procedures required for the specific objectives, it had the fewest action verbs. Despite this, the curriculum developer in some situations may want the teacher to add more information to the lesson notes and planning based on their training, current expertise, and knowledge of the content in some cases. The syllabus [21] indicated how the specific objectives are stated in terms of what the students would achieve during and after teaching and learning. Therefore, more significant anticipation was expected from the "objective column" to display more action verbs but fell behind "Teaching and Learning Activities."

The fact that the cognitive action verbs (in the matrix) were the least recorded does not mean that the SHS core mathematics syllabus is deficient in knowledge [21]. These verbs rightly test their knowledge and understanding of the mathematical problem at stake. Nevertheless, aesthetics (innovation and creativity) verbs, self-actualization (analysis) verbs and transcendence (application) verbs situate in the application of knowledge as confirmed by the Ministry of Education [21]. These findings are consistent with the ultimate aim of achieving the objectives of this new mathematics curriculum as stated by Ampadu (2013). It means that the growth stage of the hierarchy of needs is made up of knowledge, understanding, and application of the action verbs.

Mathematics has a hierarchy of needs, from beginner to advanced stages as confirmed by Hassi et al. [58], which is an epitome of Maslow's hierarchy of needs. The action verbs do not necessarily follow the hierarchy of needs. Conversely, from the more excellent perspective, although it works quite often. There is no need for students to pass through Maslow's Hierarchy of Needs to reach the transcendence stage before they can; apply, assist, guide, encourage, discuss, emphasize, illustrate, and share, to mention but a few, and acquire mathematical knowledge with others. The finding is consistent with King-Hall's [53] and Tay and Diener's [54] criticism of Maslow's hierarchy of needs. Wahba and Bridwell's [55] claim to show a limited explanation for the systematic pursuit of needs has become clear in the findings as one can pursue different levels at the same time rather than one after the other, while personal preference can also determine which levels of the stage students aim for the most. The fact that there is a discussion in the hierarchical order of all the identified observable action verbs in the curriculum means that the curriculum meets all of the student's needs. When students need basic survival items, learning cannot take place smoothly in the mathematics classroom. To meet these physiological needs, it is not surprising to see free hot meals provided to all students in SHS and elementary schools. The findings have revealed this goal as a major motivator for more excellent implementation of Maslow's Hierarchy of Needs in our mathematics classes [18], [23], [24].

5. IMPLICATION AND CONCLUSION

According to eight Maslow's Hierarchy of Needs, the study's findings identified 217 observable action verbs that appeared in the objective, content, teaching, learning activities, and assessment columns of the Ghanaian SHS core mathematics syllabus. The study found that every action verb reflects the essential profile element for every goal. The cognitive needs in the matrix (row-wise direction) were evaluated using the fewest action verbs, according to statistical research. The study uncovered how the curriculum developers want students to obtain the majority of their needs through these actions in the teaching and learning column of Maslow's hierarchy matrix.

However, the findings demonstrated that all the action verbs defined as cognitive, aesthetic, self-actualization, and transcendence requirements are cognitive. This implies that teachers should adequately assess students' knowledge and understanding, invention and creativity, analysis and application, as these are the developing requirements in Maslow's Hierarchy of Needs. To expose students to the practical application of their cognitive abilities to apply their knowledge and understanding, teachers must also assign critical thinking exercises and practical word problems for them to solve. As a result, teachers are advised to utilize action verbs based on the topic's declared objective to fulfill the set goals. Future research should examine if the 21st-century skills applied in the mathematics curriculum follow the stages in the hierarchy of needs.

The Ghana government can enhance students' overall development by teaching mathematical principles by integrating Maslow's action verbs into the mathematics curriculum. This approach ensures that the curriculum meets the diverse needs and aspirations of Ghanaian students, addressing their fundamental necessities, safety, social connections, recognition, and opportunities for growth and self-fulfillment. Such integration creates a more engaging, relevant, and supportive learning environment, fostering both mathematical proficiency and holistic student development.

REFERENCES

- [1] E. Adodey and J. A. Ansah, "Differentiated Curriculum: The Perspectives of the Special Educationist," *Research on Humanities and Social Sciences*, vol. 7, no. 23, pp. 26–33, 2017.
- [2] I. Buabeng, D. F. Ntow, and D. C. Otami, "Teacher Education in Ghana: Policies and Practices," *Journal of Curriculum and Teaching*, vol. 9, no. 1, pp. 86–95, 2020, doi: 10.5430/jct.v9n1p86.
- [3] K. Acheampong, "Teacher Educators' Practice and Vision of Good Teaching in Teacher Education Reform Context in Ghana," *Educational Researcher*, vol. 46, no. 4, pp. 194–203, 2017, doi: 10.3102/0013189X17711907.
- [4] S. A. McLeod, "Maslow's Hierarchy of Needs, Retrieved from <http://www.simplypsychology.org/maslow.html> on 15/05/2022," *Simple Psychology*.
- [5] A. Neher, "Maslow's Theory of Motivation: A Critique.," *Journal of Humanistic Biology*, vol. 31, no. 3, pp. 89–112, 1991.
- [6] G. Howson and B. Wilson, *School Mathematics in the 1990s*, 1st ed. in ICMI Study Series. Cambridge: Cambridge University Press, 1986. Accessed: May 18, 2022. [Online]. Available: https://www.researchgate.net/publication/350989918_Sixty_years_of_teacher_education_in_Ghana_Successes_challenges_and_the_way_forward/link/6087e42d2fb9097c0c0fd9f6/download
- [7] J. Adu-Agyem and P. Osei-Poku, "Quality Education In Ghana: The Way Forward," *International Journal of Innovative Research and Development*, vol. 1, no. 9, pp. 164–177, 2012.
- [8] H. O. A. McWilliam and Kwamena-Po, *The Development of Education in Ghana*. Hong kong: Longman, 1978.

-
- [9] D. K. Mereku, "Five Decades of School Mathematics in Ghana," *The Mathematical Association of Ghana*, vol. 9, pp. 73–88, 2010.
- [10] D. K. Mereku, "School Mathematics in Ghana: 1960 - 2000," Denu, Ghana: Mathematical Association of Ghana, 1999, p. 7.
- [11] G. A. A. Williams, "The development of a modern mathematics curriculum in Africa. The Arithmetic Teacher," vol. 23, no. 4, pp. 254–261, 1976.
- [12] H. Gbagolo, "Examination Malpractices in Nigeria: A Review of Literature," *Continental J. Education Research*, vol. 4, no. 3, pp. 34–43, 2011, doi: 10.1.1.367.7889.
- [13] R. Pinto, "The Effect of Western Formal Education on the Ghanaian Educational System and Cultural Identity," *Journal of Negro Education*, vol. 88, no. 1, pp. 5–16, 2019.
- [14] AMTE, "Position of the Association of Mathematics Teacher Educators on Technology," Press Release: AMTE Statement on Technology | AMTE. Accessed: May 15, 2023. [Online]. Available: <https://amte.net/news/2022/06/press-release-amte-statement-technology>
- [15] I. V. S. Mullis and M. O. Martin, *TIMSS 2019 Assessment frameworks*. Commonwealth Avenue, Chestnut Hill, MA: TIMSS & PIRLS, 2017. [Online]. Available: timssandpirls.bc.edu/timss2019/frameworks/
- [16] OECD, *PISA 2015 Results (Volume I): Excellence and Equity in Education*, vol. 1. Paris: Organisation for Economic Co-operation and Development, 2015. Accessed: Oct. 03, 2022. [Online]. Available: <https://doi.org/10.1787/9789264266490-en>
- [17] M. Alagaraja and N. Arthur-Mensah, "Exploring technical vocational education and training systems in emerging markets: A case study on Ghana," *European Journal of Training and Development*, vol. 37, no. 9, pp. 835–850, Jan. 2013, doi: 10.1108/EJTD-04-2013-0037.
- [18] E. A. Quainoo, F. Quansah, F. Adams, and E. Opoku, "Comparative Review of Educational Reforms, Policies, and Systems: A case of China and Ghana," (*JCSIE*), vol. 2, no. 1, Dec. 2020, Accessed: Mar. 20, 2022. [Online]. Available: <https://www.jcsie.com/ojs/dir/index.php/JCSIE/article/view/20>
- [19] D. D. Agyei and J. Voogt, "ICT use in the teaching of mathematics: Implications for professional development of pre-service teachers in Ghana," *Educ Inf Technol*, vol. 16, no. 4, pp. 423–439, Dec. 2011, doi: 10.1007/s10639-010-9141-9.
- [20] E. Oppong-Gyebe, E. Bonyah, and L. J. Clark, "Constructive instructional teaching and learning approaches and their mathematical classroom teaching practices: A junior high school perspective," *CONT MATH SCI ED*, vol. 4, no. 1, p. ep23002, Jan. 2023, doi: 10.30935/conmaths/12541.
- [21] Ministry of Education, "Teaching Syllabus for Core mathematics (Senior High School)." Curriculum Research and Development Division, MOE, Ghana, 2010.
- [22] E. Ampadu, "Implementing a new mathematics curriculum: Mathematics teachers' beliefs and practices," *IJRSE*, vol. 3, no. 1, Oct. 2013, doi: 10.5861/ijrse.2013.562.
- [23] G. P. Atta and Manu J., "Ghana School Feeding Program: A Retrospective Review," *International Journal of Innovative Research and Development*, vol. 4, no. 8, pp. 402–410, 2015, doi: 10.1.1.1004.5802.
- [24] T. Chanimbe and O. K. Dankwa, "The 'New' Free Senior High School Policy in Ghana: Emergent Issues and Challenges of Implementation in Schools," *Interchange*, vol. 52, pp. 599–630, 2021, doi: doi.org/10.1007/s10780-021-09440-6.
- [25] E. Tamanja and E. Pajibo, "Ghana's Free Senior High School Policy: Evidence and Insight from Data," presented at the 11th International Conference on Education and New Learning Technologies, Palma, Spain, Jul. 2019, pp. 7837–7846. doi: 10.21125/edulearn.2019.1906.
- [26] G. E. S. GES, *Professional Learning Community Handbook 1. Working to the National Teachers' Standards*, 1st ed. Accra, Ghana: Ministry of Education, Ghana, 2022. [Online]. Available: https://t-tel.org/download/professional-learning-community-handbook-1-_coordinator/?wpdmdl=7650&refresh=64b2308fcdc7c1689399439
- [27] Ghana Education Service, *Professional Learning Community (PLC) Handbook. Introduction to the Senior High School (SHS), Senior High Technical School (SHTS) and Science, Technology, Engineering and Mathematics (STEM) Curriculum., Teacher Version*. Accra, Ghana: Ministry of Education, Ghana, 2023.
- [28] M. Akkus, "The Common Core State Standards for Mathematics," *IJRES*, vol. 2, no. 1, p. 49, Oct. 2015, doi: 10.21890/ijres.61754.
- [29] E. O. Aruma and M. E. Hanachor, "Abraham Maslow's Hierarchy of Needs and Assessment of Needs in Community Development," *International Journal of Development and Economic Sustainability*, vol. 5, no. 7, pp. 15–27, 2017.
- [30] R. H. M. Fallatah and J. Syed, "A Critical Review of Maslow's Hierarchy of Needs. In Employee Motivation in Saudi Arabia," *Palgrave Macmillan*, pp. 19–59, 2018, doi: doi.org/10.1007/978-3-319-67741-5_2.
-

- [54] L. Tay and E. Diener, "Needs and subjective well-being around the world.," *Journal of Personality and Social Psychology*, vol. 101, no. 2, pp. 354–365, 2011, doi: 10.1037/a00.
- [55] M. A. Wahba and L. G. Bridwell, "Maslow reconsidered: A review of research on the need hierarchy theory," *Organizational Behavior and Human Performance*, vol. 15, no. 2, pp. 212–240, 1976, doi: 10.1016/0030-5073(76)90038-6.
- [56] R. Kolstad, L. D. Briggs, and K. Whalen, "Incorporating language arts into the mathematics curriculum: a literature survey," *Education*, vol. 116, no. 3, pp. 423–432, Mar. 1996.
- [57] B. Sargent, C. Gautreau, and K. Stang, "Multicultural Considerations for Curriculum Developers of Online Courses," *International Journal of Online Pedagogy and Course Design (IJOPCD)*, vol. 4, no. 4, pp. 31–43, 2014, doi: 10.4018/ijopcd.2014100103.
- [58] M.-L. Hassi, A. Hannula, and S. I. N. Laia, "Basic Mathematical Skills and Empowerment: Challenges and Opportunities in Finnish Adult Education 2010-Jun," *Adults Learning Mathematics*, vol. 5, no. 1, pp. 6–22, 2010.
- [59] J. E. Cooper, G. Ponder, S. Merrit, and C. Matthews, "High-performing High Schools: Patterns of Success," *National Association of Secondary School Principals (NAASSP) Bulletin*, vol. 89, no. 645, pp. 2–23, 2005, doi: 10.1177/019263650508964502.
- [60] J. M. Lee and S. D. Hanna, "Savings Goals and Saving Behavior from a Perspective of Maslow's Hierarchy of Needs," *Journal of Financial Counseling and Planning*, vol. 26, no. 2, pp. 129–147, 2015, doi: 10.1891/1052-3073.26.2.129.
- [61] M. Martin, E. Fergus, and P. Noguera, "Responding to the needs of the whole child: A case study of a high-performing elementary school for immigrant children," *Reading & Writing Quarterly*, vol. 26, no. 3, pp. 195–222, 2010, doi: 10.1080/10573561003769582.
- [62] J. McLesky, N. L. Waldron, and L. Redd, "A Case Study of a Highly Effective, Inclusive Elementary School," *The Journal of Special Education*, vol. 48, no. 1, pp. 59–70, 2012, doi: 10.1177/0022466912440455.
- [63] M. Priestly, "Schools, teachers, and curriculum change: A balancing act?," *Journal of Educational Change*, vol. 12, no. 1, pp. 1–23, 2011, doi: 10.1007/s10833-010-9140-z.
- [64] P. Woolner, U. Thomas, and L. Tiplady, "Structural change from physical foundations: The role of the environment in enacting school change," *Journal of Educational Change*, vol. 19, no. 2, pp. 223–242, 2018, doi: 10.1007/s10833-018-9317-4.
- [65] T. Tambyehik and T. S. M. Meerah, "Students' difficulties in mathematics problem-solving: What do they say?," *Procedia-Social and Behavioral Science*, vol. 8, pp. 142–151, 2010.
- [66] J. E. Morin and D. J. Franks, "Why Do Some Children Have Difficulty Learning Mathematics? Looking at Language for Answers," *Preventing School Failure: Alternative Education for Children and Youth*, vol. 54, no. 2, pp. 111–118, Oct. 2009, doi: 10.1080/10459880903217861.
-

