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Grade 8 Learners' Perceptions and Misconceptions on Their Learning of Surface Area and Volume in Mathematics

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Purpose: The teaching and learning of a surface area and volume of objects/substances among high school learners had been a problematic issue for a time memorial, particularly among the grade 8 leaners. But the fact remains that surface area and volume remain common concepts that are applicable to all events related to engineering concepts on daily basis. Due to this, the researchers have taken it upon themselves to investigate the insight and perception of the grade 8 leaners on surface areas and volume when learning mathematics in high schools.

Study design/methodology/approach: To achieve the aim of this study, this article examines how Grade 8 students in a high school within the Johannesburg East District of South Africa grasp their mathematics concepts on the surface area and volume of shapes using a qualitative approach. To get a deep insight into the study after a test was conducted by the researchers to select the learners with a better understanding on surface area and volume, an interview section was also conducted.

Findings: After the collection and the analysis of the data, the researchers discovered that some grade 8 students have a weak grasp of the ideas of surface area and volume.Therefore, the finding reported that grade 8 mathematics students commit some misconceptions. And this had led to poor understanding of mathematics among the students on how to find the surface area or volume of prisms without the use of a formula. This study also discovered that students exhibit some mistakes when working through problems involving surface area and volume, such as conflating the formulas for volume and surface area.

Originality/value: This study had confirmed that there are some overgeneralisations of abilities, ideas, and formulas which was evident in their responses.

Introduction

The teaching and learning of a surface area and volume have been regarded as one of the most beneficial mathematics subject strands to measure the crucial areas of an object which remain the mathematics area which is applicable to a daily mathematics usage (Dorko & Speer, 2015; Lehmann, 2023). According to Akbaş and Yıldırım (2024) who argued that when teaching mathematics among grade 8 students, the fact remains that some aspects of mathematics like surface area and volume remains an abstract topic which could not be easily understood by the learners using some concrete examples. As a result of this, some prejudices arouse which had led to a decrease in their understanding of concepts like surface area and volume. In view of this, the importance aattached to the learning of surface area to our daily life activities were almost becoming unrealistic, on this note, the department of basic education (DBE) had selected it as an important aspect that should be included in all high school's curriculum in South Africa (DBE, 2016). Similarly, in research conducted by Lehmann (2023), to test the students understanding on the rate at which they apply diagram to report surface area and volume confirmed that 16.47% of students answered it correctly by using diagram to explain volume, while remaining over 83% of students failed to answer the concept properly. This is as result of the mistakes and misconception generated among the students during the process of learning. Despite the importance attached to this and misconceptions generated among the students, many South Africa mathematics researchers do not give a strong attention to this concept of surface area and volume among the students.

However, when considering some research in mathematics education, different researchers have reported the teaching and learning of surface area and volume in line with their importance and possible misconception with suggestions on how to resolve it, but Africa as a continent does not concentrate much on the misconceptions and errors committed by grade 8 learners when learning surface area and volume. It is on this ground that we (researchers), had taking it upon itself to investigate the Grade 8 learners' perceptions and misconceptions on the learning of a surface area and volume in mathematics education in South Africa. According to Sisman and Aksu (2016), students encountered varieties of errors and misconceptions which eventually lead to answering some mathematics question on surface area and volume incorrectly. Similarly, another study confirmed that in mathematics education, the acquisition of measurement skills has not been the subject of much research among the south Africa researchers (Chiphambo & Mtsi, 2021).

Whereas it is widely acknowledged that some students struggle with learning measurement, shapes and how to practically calculate the volume of those shapes. However, when comparing the calculation of surface area and volume of shapes to other mathematics topics taught in high school, there is a dearth of published material, especially in South Africa Chiphambo and Mtsi (2021), that offers in-depth information on the teaching and learning of measurement as a topic. Therefore, this research offers some information on the Grade 8 students' comprehension of surface area and volume as aspects of measurement in the South African context. Comparatively, when learning shapes, there are some attributes that should be considered in measurement, and this must be closely looked into, and some of these are; the measurement of a smaller units and larger units, and how they are converted into the approved unit of measurement (Dorko & Speer, 2015; Dogruer & Akyuz, 2020). For instance, the attribute of volume could be quantified in terms of the quantity of units (cubes, balls, or cups of water to fill the bucket) when comparing volume and area in standard units.

Furthermore, when learning a surface area and volume of shapes, it was also confirmed that the inadequate comprehension of surface area and volume by learners is not limited to South Africa but some other places around the world. But the fact remains that this problem had caused numerous misconceptions displayed by students when it comes to the concepts of learning surface area and volume, according to international mathematics studies (Dorko & Speer, 2015; Sisman & Aksu, 2016; Van de Walle et al., 2016). For instance, Dorko and Speer (2015) discovered that 75% of California's undergraduate student instructors had misconceptions in at least one assignment pertaining to their comprehension of prism volume and surface area. According to a study conducted by Dorco and Speer, which says that some preservice teachers in higher education learning could not fully comprehend the learning of a surface area, and this sometimes exhibit errors about the ideas of surface area and volume. This implies that the misconceptions about surface area and volume need to be thoroughly addressed in elementary and secondary schools among the learners to avoid future misunderstanding. Similarly, Sisman and Aksu (2016) also reported that some grade 8 students mistakenly believe that surface area and volume are the same thing, therefore, they define the volume and surface area of an object using their respective formulas, which occasionally switched them around. Furthermore, Van de Walle et al. (2016) also reported that students who learn surface area and volume with the aid of equations often make mistake which leads to serious misconceptions and errors.

Gathering from my experience as a Senior Phase level teacher teaching mathematics among different grades in South Africa, one of the researchers reported that the difficulties encountered by students, particularly in Grade 8, while attempting to comprehend and differentiate between the volume and surface area of given three-dimensional models remain a serious issue among them. In view of this, some students result to defining the ideas on surface area and volume of shape by reciting the corresponding formulas or by solving issues by simply entering the numerical length values into the formula. Similarly, an analysis result from the November 2016 Diagnostic Report for the Grade 8 Trends in International Mathematics and Science Study (TIMSS) showed that when it came to questions about surface area and volume, South African students' percentages of correct answers were significantly lower than the global average (DBE, 2016). Therefore, from Grade 9 Annual National Assessment (ANA) Diagnostic report from 2014 revealed that students' comprehension of surface area was insufficient; specifically, they did not comprehend the formula for calculating the surface area of a given polyhedron (DBE, 2016). For better understanding of this study, the researchers has taken it upon themselves to address the underlisted research question.

> What are the perceptions and misconceptions among Grade 8 students when learning surface area and volume in high school mathematics?

In achieving the aim of the study which is to understand grade 12 students' perceptions and misconceptions on surface area and its volume, the researchers have taking it upon themselves to adopt a qualitative approach to report their perceptions and misconception when learning surface area and volume in mathematics education.

Previous studies on learners' views and misconceptions on surface area and volume

The learning of surface area and volume demands a strong conceptual understanding which could be regarded as the measure of the quality and quantity of connections of an idea to existing ideas on surface area and volume (Van de Walle et al., 2016). Therefore, the development of new connections and the presence of pertinent concepts remains the prerequisites for the understanding of geometry. On this note, improving on the comprehension level will increase the relevant links which may perfect and improve the understanding of the spectrum that exists in an individual leaner. The was support by Herhelm (2023) who refers a relational understanding as the ability to connect ideas together rather than knowing the ideas as an isolated fact. This implies that when learners lack sufficient understanding on a particular mathematics topic, and if care is not taken to address the misconception, it could result to a poor performance and misconceptions.

Therefore, in the context of this study, the conceptual understanding of the surface area could be reported as having a vast knowledge on the total mathematics concepts that has been covered in surface areas (Cline et al., 2021). For example, for a learner to have a relational understanding of the surface area, one must paint or colour the surface of a solid. And this could be best done by making nets for solids and constructing (and deconstructing) them. The net adopted could be design in a grid of square centimetres, and its total area is counted in those units. To understand the concept of surface area, students must know the many of tiles (units) of a given size required to measure the space covering a rectangular prism. In an activity where learners cover rectangular figures with concrete materials, the use of informal units such as cards and squares before the introduction of formal units such as square-centimetre and cubic-centimetre remain important. Thus, surface area is defined as the total area of all two-dimensional (2-D) faces on a three-dimensional (3-D) shape or solid object, whether flat or curved, that cover its outer surfaces area. More one could argue that an area describes how much material is required to cover a 2-D shape. Therefore, the most fundamental property of surface area is its summation, which is the area of the entire shape, calculated as the sum of the areas of all 2-D parts.

However, the conceptual understanding of volume can be understood as the volume that a solid claim, as free space inside a closed surface, as the volume of material that fills a receptable like several cubic units or, in another way, as the volume that a solid displaces when it is placed into a liquid (Sáizs, 2003). It has been confirmed that the two methods for measuring volume involve the approach of packing the space with a three-dimensional array which is made up of units from a two-dimensional array that is repeated in the third dimension. Another approach is a fluid unit that adopts the shape of the container is used to fill the space. The unit structure in this method is one-dimensional. To distinguish them, these two approaches are referred to as volume (packing) and volume (filling) respectively. For instance, students must calculate how many blocks and cubes of a certain dimension they believe are necessary to measure the interior of a box. As an alternative, have a student fill a cup with rice, transfer the rice to a jug, then shake the jug to level the rice. There is now one cupful of rice in the jug—a unit. They must ascertain the number of cupsful, or units, of rice required to fill the jug.

In contrast, memorising the formula for how to calculate the volume or surface area of a solid is a common rote activity found this day among the students. For instance, if some learners have no concept behind this rote learning, then this explains why surface area and volume "do not exist" (for those learners) when there are no lengths to substitute into the formulas. For example, learners could define volume as Length (L) X Breadth (B) X Height (H) and, when probed, learners indicate that there is no other way of defining a volume. Most learners think that when measuring volume, length, width, and height measurements should be given. They believe that only with these measurements can volume be calculated. This is an instrumental understanding—rules without reasons.

However, despite the methods for calculating surface area and volume as suggested by the researchers as stated above, there are several misconception and errors committed by some students when learning surface areas and volume. According to Jameson et al., (2024), misconceptions are described as the errors or erroneous replies that are systematic in the sense that they are applied repeatedly in the same conditions. These misconceptions are arguably meaningful and practically, defensibly correct, from the learner's perspective; hence many researchers prefer referring to them as alternative conceptions (Brodie, 2009). Similarly, Sarwadi and Shahrill (2014) describe misconceptions as gaps arising from an inability of learners to assimilate and accommodate new knowledge into their prior knowledge. Brodie (2009) considers a misconception as part of a faulty cognitive structure of ideas in the learner's schema that causes, lies behind, explains, or justifies an error. Learners usually tend to defend the way they perceive things, even when no one can make sense of their suppositions. It becomes the mathematics teacher's role to undo the faulty structures and replace them with real or true concepts that can then equip the learners to explore the world around them.

Problem statement

For over 20 years, the teaching of mathematics among Grade 7 to 9 in some south Africa public school has been given to one of the researchers. But, during a personal review, we have observed that some of the students encountered different difficulty that are attached to some important mathematical courses like surface area and volume, particularly among Grade 8 students. while trying to be attempting to comprehend and differentiate between the volume and surface area of given three-dimensional models, I observed some misconceptions. It is on this ground that some students define the ideas of surface area or volume by reciting the corresponding formulas, and this had created some gaps in the understanding of surface area and volume. To fill the gap created in the space of teaching and learning, the researchers had taken upon themselves to investigate the Grade 8 learners' perceptions and misconceptions on their learning of surface area and volume in mathematics education in South Africa.

Research Questions

According to Jameson et al. (2024), which reported that, some students encountered some misconception when learning some mathematics related topics such calculus as some geometry related topics. On this note, this study was guided by a research question which says.

> What are the perceptions and misconceptions among Grade 8 students when learning surface area and volume in high school mathematics?

Conceptual Framework

Previous theories and frameworks have reported the learning of surface area and volume, among which are Jameson et al. (2024), and Battista (2003) who identified the five most reported learner misconceptions in comprehending the concept of surface area and volume, which became my conceptual framework with modifications from Jameson and others. These are: Treating 3-D figures as 2-D ones; Counting visible faces or unit cubes instead of calculating the volume thereof. Enumerating cubes in 3-D arrays incorrectly. Believing that a shape has more than one surface area; and confusing the concept of volume with that of surface area, including interchangeable use of their formulae. All these concepts identified had reported the conceptual aspects of the learning. To support the other factor that contributed to the learning of surface area and volume and the misconceptions involved, a recent study published in mathematics education journal clearly argued of some important concepts. On this note, one could report that when talking about the misconceptions, it is empirically confirmed that some crucial aspects should looked at and this include, the conceptual aspects which talk about the students understanding on the 3D objects, 2D objects, counting visible faces, and their errors with a connection with the impact of nature and nurture (Jameson et al., 2024). Diagrammatically as shown below.

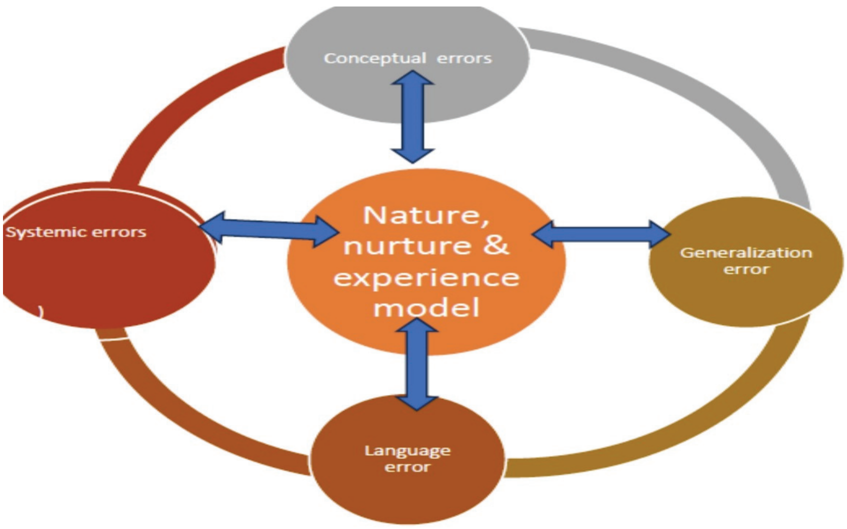


Figure 1. Nature-nurture conceptual model (Jameson et al., 2024)

According to Jameson and others, who reported that when learning some mathematical topics some forms of misconceptions do arise as a result a poor understanding of conceptual/contextual aspect of the topics, and if not well engaged may result to misconception and errors Jameson et al., 2024. Therefore, when handling some mathematics topics like surface area and volume, some students are face with some problems of logical steps of doing those mathematics concepts. Also, a poor understanding of some mathematics language that are common to some students when interpreting the given mathematics questions. More so, when teaching and learning surface area and volume, avoiding a systemic error remain important due to its important to the learning of mathematics. In a nutshell, the learning of surface area and volume remain a topic with some challenges attached to its human ability which involved the nature and nurture, therefore, considering some aspects like the nature and how the learners were trained remain vital to the processes of teaching and learning.

Methods/methodology

This section describes the study's methodology, covering research design, participant selection, data collection and analysis, and ethical considerations. These stages ensured the study's accuracy, reliability, and validity.

Research Paradigm

A paradigm is a set of values, beliefs, and practices that serve as the foundation for a certain way of thinking about the world. As a result, a research paradigm is a framework, model, or method used in research. This research approach is informed by the research philosophy, which was develop with the aid of the research paradigm. Therefore, for the purpose of this study, an interpretive phenomenological paradigm was used to report the views of Grade 8 students learning surface area and volume in high school (Lim, 2024).

Research Design

The methodological procedure adopted for gathering and analysing of data to meet the study's goals is known as research design. It also describes how to obtain the pertinent data needed for the investigation (Creswell & Poth, 2016; Lim, 2024). Considering this, our study was conducted by utilizing a convenient and purposeful selection technique, choosing a sample of Grade 8 math students from one of Tshwane's high schools in South Africa. This was carried out since it was simple and convenient to contact the students, just because one of the researchers worked as a teacher at the school. Furthermore, a mixed method approach was employed during the process data collecting by giving students a questionnaire and conducting one-on-one interviews to enable for the achievement of the study's goal.

The accessibility of an in-depth interview was done after the researchers had collected the students' questionnaires from them with a thorough analysis to understand the students with strong ideas of the study. Furthermore, to gather our data and get an in-depth knowledge of the students' misconceptions when learning surface areas and volume, the researchers selected 6 grade 8 students for the study. On this note, a semi-structure interview guide was used to collect their knowledge on the surface areas and the misconceptions reported by the students. The participants further explained their understanding of the concepts and the methods used in solving problems through the test conducted by the researchers.

Participants

Prior to the beginning of the data gathering process, the researchers took time to choose the right sample of Grade 8 students from a high school in Tshwane who were engaged in mathematics instruction. As a result, 29 were given some questionnaires, after which six students were chosen based on their ideas on surface area and volume during the test that was also conducted by the researchers. After which their worksheet was used to select the students appropriate for an interactive interview section. A quantitative result of the 29 students initially adopted were analysed by the researchers. The text conducted by the researchers was used to find out the students' ideas on surface area and volume. In conducting an in-depth interview, one of the researchers who participated in the process endeavoured to develop close, trust-based relationships with the students which eventually assist the process and make the to give some authentic disclosures about their thoughts (Creswell & Poth, 2016).

Ethical Consideration

Before beginning the process of data collection process, the students were asked to sign a written consent form that the researchers provided to them to report the uniqueness of the study and receiving their consents to meet up with the international practices.

Data Collection Tools/instruments

After obtaining the ethical clearance, interacting with the students was made simple with this strategy. Since one of the researchers was a teacher at the high school, and could easily access the students, on this note, he (teacher) participated in the data collection procedure. Furthermore, he comprehends the specification of the mathematics curriculum for Grade 8 with regards to surface area and volume. It is on this note that the researcher consulted the students at their convenient time since he understands the actual time that is appropriate for this purpose.

Data Presentation and discussion of Results

This section of the study presents the available data to report the Grade 8 learners' perceptions and misconceptions on the surface area and volume, this was done to describe the misconceptions that are evident among the learners in areas like, definition, description, and when solving mathematical problems related to the surface area and volume. In reporting the views and the understanding of the students on the meaning of surface area and volume, table 1 shows how the participants responded to each question in the test. The responses are coded correct, partly correct, incorrect, and not attempted. The learners were coded correctly in line with given responses, while partly correct was given to the leaners with at most one of the required characters found in the response, but left the other, while those coded incorrect had not managed to identify any of the features in each section. The number of learners, as well as the percentage in each code, is recorded on the table below.

Given the extremely low number of "C- Correct" answers on numerous questions in Table 3, most of the students did poorly on this test. The result of the test conducted show that out of the 29 students that participated in the study in question 1a, 8 students which is 28% of the participants got the answer correctly after grading. While 16 students which is equivalent to 55% to the answer partially. It is significant to know that the number of students that got the answer is 24. This means that a high number of students have a better understanding of surface areas of geometry and its volume. On the second question 1b, 24% of the students got the answer to the given question correctly, while 32% of the students partially got the answer to the given question testing their understanding on surface area and volume of an object. This shown a high understanding of the learners on the given question. On the other hand, the result of Q2 and Q3 shows that the students possess some level of misconceptions when learning surface area and volume, which affect their performance. A detail explanation and discussion on students' views is hereby presented below.

Table 1: Distribution of Learners' Responses to the Test Items

Test Item	Code of responses per test item			
	Correct	Partly correct	Incorrect	Not attempted
1a	8/29 = 28%	16/29 = 55%	4/29 = 14%	1/29 = 3%
1b	7/29 = 24%	9/29 = 32%	10/29 = 34%	3/29 = 10%
2a	0/29 = 0%	5/29 = 17%	18/29 = 62%	6/29 = 21%
2b	4/29 = 14%	0/29 = 0%	16/29 = 55%	9/29 = 31%
3a	1/29 = 3%	4/29 = 14%	15/29 = 52%	9/29 =31%
3b	8/29 = 28%	3/29 = 10%	11/29 = 38%	7/29 = 24%
3c	0/29 = 0%	3/29 = 10%	18/29 = 62%	8/29 = 28%
Total	**28/203**	**40/203**	**92/203**	**43/203**
%	14%	20%	45%	21%

Grade 8 students' perceptions about the meaning of volume of a substance

The aim of this section was to ascertain the definition of volume used by students in Grade 8 curriculum, and this was done to confirm the myth that volume and surface area are the same thing. The most acceptable answer was that a 3-D object's volume is the quantity of space it occupies. It is also possible that participants describe volume as a measure of how much space an object or substance occupies. Going by the descriptions in table 1, which indicated that 28% of the participants in this study accurately identified volume, while the remaining 55% defined volume in part. On the other hand, 72% of the participants had difficulty in defining the volume, while five out of the 29 participants defined volume as the amount of space an object occupies in response to Question 1a. Conversely, three participants defined volume by referring to the formula for calculating prism volume, while four participants defined volume as mass. Based on these facts, 12 out of 29 individuals had misconceptions about what volume is all about. These misconceptions that were identified include mixing up volume and mass or formulating something without first defining it. As seen in figure 2, Participant A3 defined volume as follows.

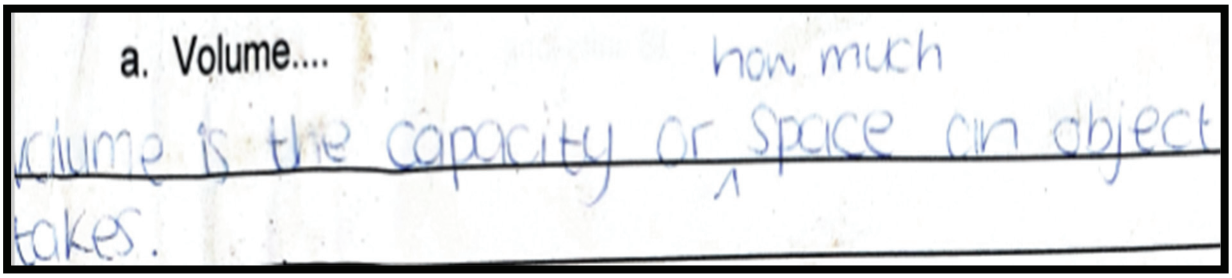


Figure 2: Participant A3's response to Question 1a

This response appears to be a simple reminder of the definition, as volume had previously been equated with capacity. When probed more, Participant A3 said, "*No sir, capacity measures liquids, it is the amount of space an object takes up.*" A similar argument is portrayed by participant C3 in figure 3, who erroneously referred to volume as "matter," then defined it by the formula: length x width x height.

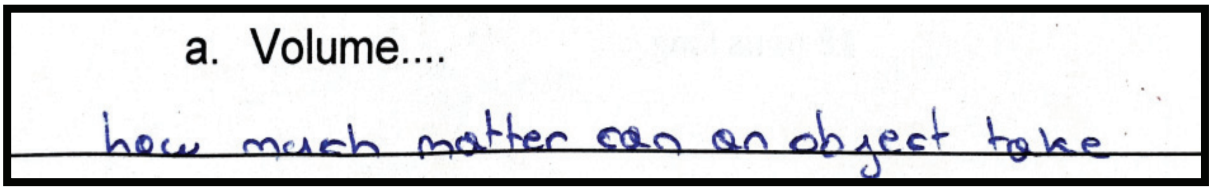


Figure 3: Participant C3's response to Question 1a

When Participant C3 was asked to explain what he meant by volume is "how much matter an object takes," Participant C3 said,

> *I do not know how to explain it, but kind of like this piece of paper, how much space it takes, as the space around us. The height of a piece of paper is 0,001 mm. It is going to be Length x base x height then we find the volume of this paper.*

The participant understood the formula for calculating the volume of prisms, but it was difficult to articulate the notion. Furthermore, there was a noteworthy misperception that 2-D space was 3-D (Dogruer & Akyuz, 2020), as demonstrated by the learner's illustration of the volume of a piece of paper. This follows the argument that at the Grade 8 level, volume is measured 3-D instead of 2-D space Nevertheless, participant C3 displayed a rare learner conceptualisation phenomenon in considering that a single page has some height, resulting in a book of a thousand pages consisting of some volume. Contrary to participants A3 and C3, participant G3 defined volume as mass.

This was confirmed with the response which says that.

Participant G3

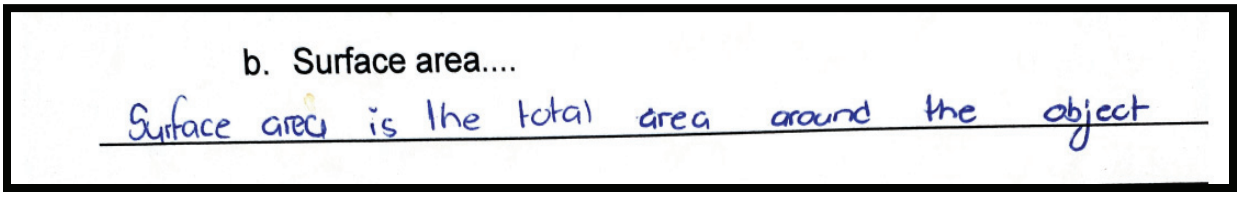
> *"I meant that volume is the total capacity, the weight; no that's not it, total capacity, total something ... how much air it has."*

From their responses, some students linked the definition of volume to a description of a formula, therefore, most of the students in the study showed evidence of this term of reference, which demonstrate that some students lacked the conceptual knowledge necessary to engage with the mathematics they had learned. The learner first confused volume and capacity, even though participant A3 only had a vague idea of what volume was. While matter has both mass and volume, participant C3 mistakenly believed that volume equals matter. Learner C3 made a glaring example of a misunderstanding when he said that a piece of 2-dimensional paper has volume. It is interesting to note that the learner determined a piece of paper's height to be 0,001 mm, reasoning that this should lead to the volume being computed using the formula L x W x H. Participant G3 mistook volume for mass. This has confirmed that some Grade 8 students were unable to articulate the concept of volume conceptually and instead resorted to providing the formula for calculating prism volume. In addition to this conceptual ignorance, students confused volume with capacity. Of the students surveyed, 17% mistook volume for mass, weight, and matter. This goes in line with the views of Sisman and Aksu's (2016) and Dogruer and Akyuz (2020) who argued that some students do face some challenges when learning surface area and volume which result to misconceptions and errors if not properly managed.

Grade 8 students' understanding on the meaning of a surface area in geometry

This question sought to investigate learners' definitions of surface area much the same as question 1a. The best explanation would have been that surface area is the total area of all a three-dimensional shape's or solid's faces. The fact that surface area indicates how much material is needed to cover the 3-D object's 2-D faces might have also been brought up by participants.

According to table 1, 24% of participants provided accurate answers. Form the table 1 above, a surface area was defined in part by 32%, while 44% of the students had no idea what surface area was all about. Therefore, six participants characterised surface area as volume in their response to question 1b, while three of these learners even provided their calculation on the volume of substance to back up their argument. These answers support the fifth misunderstanding in the conceptual framework, which is the idea that surface area and volume are interchangeable with the formulas inclusive. On this note, instead of the four participants to describe the surface area as the boundaries surrounding an object in two dimensions, they commit several misconceptions, therefore, 45% of the participants had trouble determining surface area. As seen in figure 4, for instance, G3 stated:


b. Surface area....

Surface area is the total area around the object

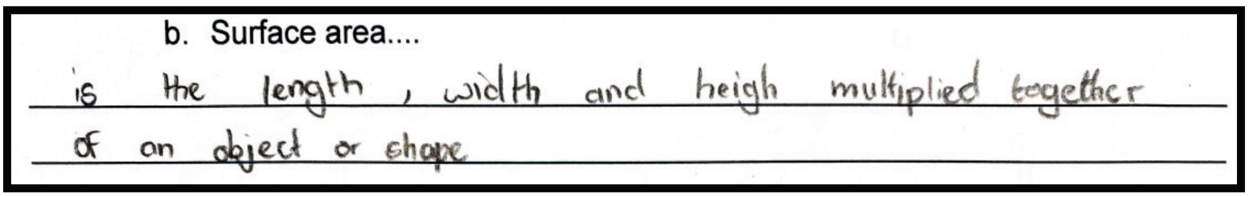
Figure 4: Participant G3's response to Question 1b

When G3 was asked what he meant by "Surface area is the total area around the object."

He responded that,

> *"It is the distance around the object. It is a distance between the surface of all the sides."*

Comparing volume to mass, participant G3 first interpreted perimeter as the surface area, which is comparable to the misunderstandings addressed in Question 1a. In a similar vein, participant N3 misinterpreted the volume for surface area in her response. According to figure 5, she stated,


b. Surface area....

is the length, width and heigh multiplied together of an object or shape

Figure 5: Participant N3's response to Question 1b

When she was asked to define surface area without using a formula, she said,

> *No, first they must give you the length, the height and the width. I would find the surface area and then multiply by 2 to find volume because the volume is much heavier per se. I wanted to show how it is calculated.*

Participant N3, as shown in figure 5, surface area and volume were confused, and the formulas were interchanged. The participant went on to discuss an inaccurate method for calculating volume based on surface area.

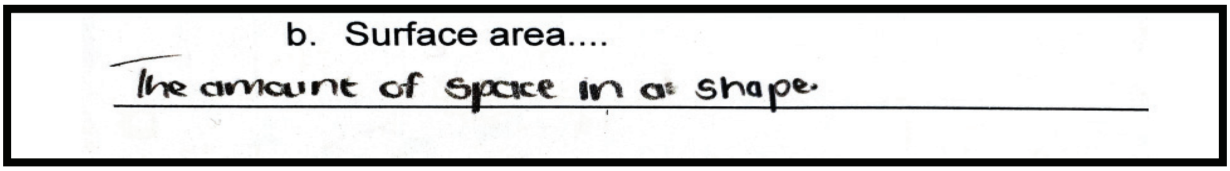


Figure 5: Participant Q3's response to Question 1b

Similarly, participant Q3 also said,

> *"I think it is the calculation of the whole shape, like how much is inside. The measurement of the object, yeah, that's what l wanted to say."*

Researcher: *If you look at the first aid kit here, which one would you say is its surface area?*

> *Participant Q3: It would be the outside of the object, if you know what I mean?*

Researcher: What about the outside?

> *Participant Q3: Its measurements. I think.*

It was evident that participant Q3 mistook the perimeter for the surface area by providing the formular for calculating volume. For purpose of clarity, when asked to specify the surface area, participant Q3 appeared to allude to volume. The answers above made it evident that the learners found it more difficult to define surface area than volume. This corroborate with a researcher who argued that the surface area of objects is often mistaken for volume (Battista, 2003).

Gathering from the responses above, one could argue that some students who tried to define surface area were unable to describe how the entirety of the faces around a 3-D object is contained inside the area. According to Sisman and Aksu (2016), learners misinterpreted 3-D shapes as plane shapes when they attempted to describe the regions of the 2-D shapes surrounding a 3-D solid, instead defining the perimeter. Eighty-three percent of the participants had numerous mistakes when accounting for surface area. The formula for determining the volume of prisms was provided by some students, who confused surface area with volume. Others saw surface area as the space inside a shape. Most of the time, surface area was confused with volume and used interchangeably (Dogruer & Akyuz, 2020). This outcome is also consistent with that of Dorko and Speer (2015), who found that 78% of students in postsecondary education had misconceptions about surface area comprehension.

Grade 8 students' understanding on the determination of the volume of prisms without using a formula.

To answer the second question 2, students had to explain how to calculate a prism's surface area and volume without using any formulas. The purpose of this was to find out if students were more at ease in describing the actions or processes than supplying volume and surface area formulas. Table 1 revealed that none of the participants answered this question correctly.

Gathering from the table 1 above, 7% of participants gave partially accurate responses, 62% gave incorrect answers, and 21% gave no response at all. These numbers show a severe lack of terminology to explain how prism volume could be explained. It also suggests that there is a lack of knowledge and proficiency in describing and clarifying the process of learning. Therefore, it was discovered that students could compute their way through a few problems requiring surface area and volume but were unable to explain the necessary steps. One could argue that the best way to answer this question would be to count how many unit cubes were needed to form the desired shape. Since the question did not permit the application of a formula, other solutions such as the displacement of liquids in measuring cylinders followed by the conversion of capacity units to the volume were equally appropriate.

From the result in table 1 above, it is significant to note that 59% of participants used a formula in their response, which went against the instructions for the question. Therefore, the test item misinterpreted was this one that explain how to determine the surface area, this shows that 5 out of the 29 participants discuss the 2-D figure that are created, while 3-D objects are opened. This verified the assumptions that 3-D objects should be treated like 2-D figures and that surface area and volume are interchangeable (Dogruer & Akyuz, 2020). As an illustration, as seen in Figure 9, A3 stated:

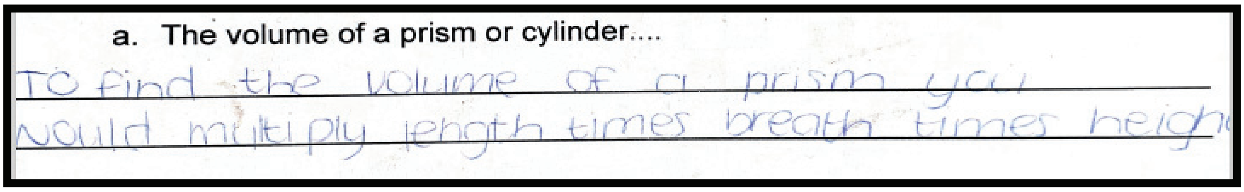

a. The volume of a prism or cylinder....
To find the volume of a prism you would multiply length times breath times heigh

Figure 6: Participant A3's response to Question 2a

When the researcher reminded participant A3 about the question which prohibited the use of the formula and requested her to provide another way of describing finding volumes of prisms without the use of a formula, she said, *"No, the question says you can't write the formula sir, but they didn't say you can't use it in words. I used words to explain the formula."* When the researcher pushed to provide another way she can explain, without mentioning the formula, she said, *"I am not sure, Sir, this is the only way l can explain it".*

However, participant A3 claimed that the formula "length x breadth x height" was the only method available for determining a prism's volume. It is incorrect to describe a process using a quantitative formula. This is not one of the misconceptions shown in the conceptual framework, which is another one that was found during the study. As seen in Figure 10, participant N3's written work reflected the observation from Participant A3. The idea that a quantity can be defined and/or described by its formula is confirmed by a formula that was submitted in place of instructions on how to calculate volume.

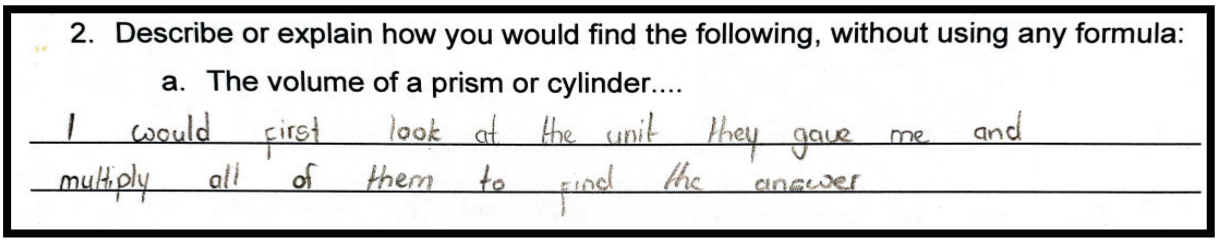

2. Describe or explain how you would find the following, without using any formula:
a. The volume of a prism or cylinder....
I would first look at the unit they gave me and multiply all of them to find the answer

Figure 7: Participant N3'sresponse to Question 2a

In the justification of her response, N3 said,

> *"In my opinion, you cannot, because the formula is the math, everything needs a formula, without the formula you can get it by chance, once or twice but not always, it's not guaranteed."*

As stated by participant N3, the learner thought that using a formula was the only method available for determining a prism's volume. The student persisted in saying that a formula was the centre of all things mathematical. As Q3 in Figure 11 illustrates, this was the most common mistake in this question and across the survey.

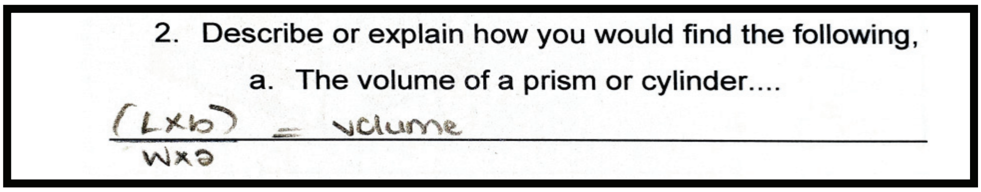


Figure 8: Participant Q3's response to Question 2a

When asked to justify her solution, participant Q3 said,

> *"I think I did it wrong because I used the formula, I should have done the calculation of…, you know the calculation of a rectangle or perimeter. I think I was thinking of an area... I gave the wrong formula".*

Three more mistakes were made by participant Q3's, and these are shown in his response. And these responses are; the first one which state that the area and volume were equal; two, that the volume and perimeter were equal, and three, the suggestion that proved that the volume of a rectangle might be determined which is totally misconception. The misperception that 2-D figures should be treated as 3-D shapes was reveals a form of inaccuracies found in his response and was supported by (Dogruer & Akyuz, 2020). Table 1 shows that just 17% of participants answered this question partially correctly, with a significant frequency of misconceptions. No participant answered this question correctly. This indicates that 83% of participants had trouble explaining how to determine the prisms' volume, which is regarded as a major source of misconceptions.

Grade 8 students' understanding on the strategies of calculating the surface area of prisms without using formulae.

Similarly, question 2b also assessed the respondent's capacity to explain how to calculate surface area without the use of a formula, and the question asked the participants to indicate that they would draw the nets of all the prism faces, determine the areas of each face, and then calculate the total surface area by adding up all the areas. The result from table 1 reveals that just 14% of participants answered this question correctly, while 55% provided false information and 31% were unable to respond at all. According to this result, 86% of participants were unable to explain how to determine the volume of a prisms. The low number of right responses demonstrates how challenging it is to provide conceptual, mathematical explanations on the calculation of surface area of a prism without using formula.

Comparing this result to question 2a, the primary misunderstanding raised in this question was replacing a description with a formula. Therefore, 14% of the participants attempted to provide a formula for calculating the surface area of prisms; however, some of them wrote it incorrectly. As seen in figure 12. The sample of participant A3 respond is hereby displaced below.

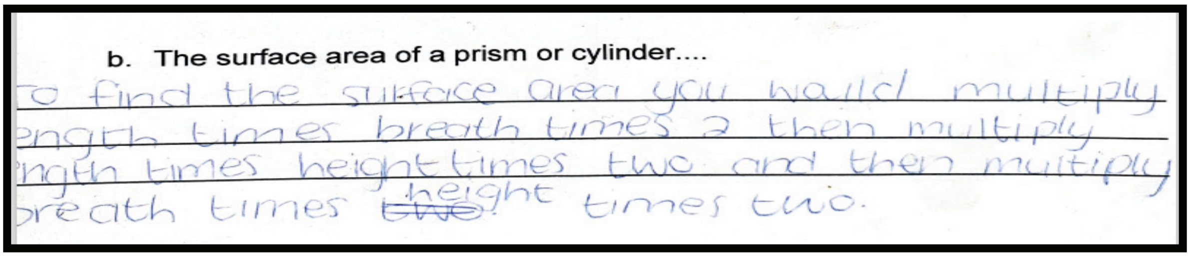


Figure 9: Participant A3'sresponse to Question 2b

When the researcher asked participant A3 to describe how he found the surface area of a prism without using a formula, he said,

> *"It is length x breadth x 2 + length x height x 2 + breadth x height x 2, that is the formula." When the researcher probed more, he said, "It is not possible. You will need the units and a formula for surface area."*

Therefore, rather than explaining the method for obtaining the surface area, participant A3 gave the formula. The usage of cubic and square units to describe the same phenomena indicates that the learner confused surface area with volume processes. It is imperative for an observer to draw the conclusion that the concepts were not sufficiently addressed for the learner to independently understand and comprehend the information to properly apply it in various future situations.

In response to the identical query, participant G3, depicted in Figure 13, stated:

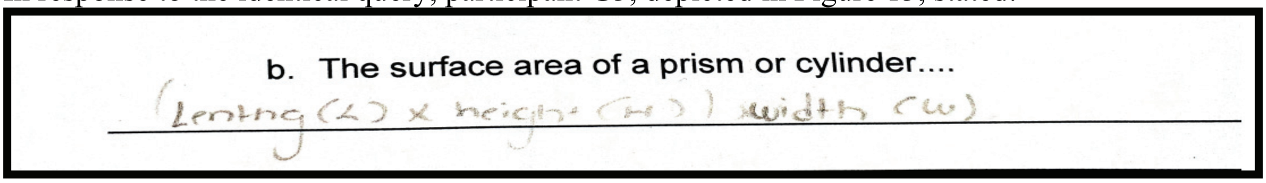


Figure 10: Participant G3'sresponse to Question 2b

When asked to justify her response, participant G3 said*,*

> *"It would be the length times the height times the width. That is impossible, sir, surface area needs a formula, always."*

Instead of discussing how to find the surface area of a prism, participant G3 provided the formula for calculating its volume. This misunderstanding comes inform of a confusing of surface area with volume and interchanging the formula which goes in line with Dogruer and Akyuz (Dogruer & Akyuz, 2020).

As illustrated in Figure 11, participant N3's description was as follows:

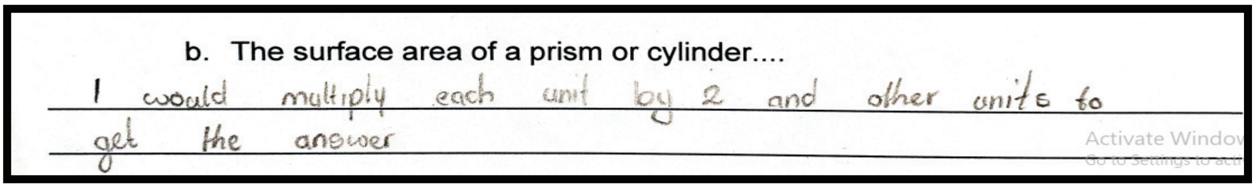


Figure 11: Participant N3'sresponse Question 2b

Participant N3 seemed to concur with participant G3 in assuming that only the formula describes the surface area of a prism. Having responded to Question 2b with a formula, as shown in figure 12, participant Q3 argued as follows:

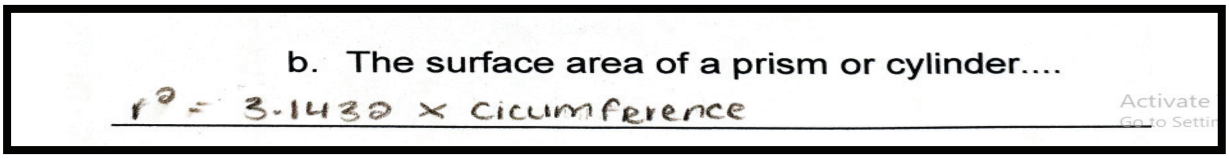


Figure 12: Participant Q3's response to 2b

When participant Q3 was questioned and responded,

> *"You would confuse yourself if you tried to find the surface area and volume without the formula."*

Participant Q3 shared the same perspective and way of thinking as participants N3 and G3. Therefore, every participant connected any explanation and method for determining the surface area to a formula of some kind. According to four participants, this is a misperception that stems from the topics being introduced using the formula. This goes in line with Machaba (2016) who argues that when learning surface area and volume, there is a tendency of misunderstanding of the formula and concept. Therefore, some of the common misunderstanding on these topics occur due to the misapplication of the mathematical phenomenon which can only be described by the formula. On this note, 14% of participants were able to accurately describe how to find surface area, while 17% of people attempted to describe how to find prism volume without using a formula. This corroborate with the views of the students who argued that some students were closer to a reasonable response of the answer when learning surface area and volume, while some just use the corresponding equations without providing the details (Tůmová, 2017). On this note, it could be argued that the use of formulas for calculating the volume of a prism and surface area were overly generic and were utilised in lieu of definitions or descriptions. Therefore, sometime, learners' knowledge of surface area or volume was restricted to formulaic applications. The participants showed oversimplification of the facts by acting in this way. Oversimplification of the facts was consistent with and supported by Brodie's theory (Brodie, 2009). This was in line with the findings of Brodie (2009) study, which suggested that some students possessed their procedural knowledge as opposed to conceptual knowledge. This was supported by Machaba (2016) and Moyo and Machaba, (2021) who argued that students only believe in procedural knowledge thereby neglecting the importance of having a conceptual knowledge.

Grade 8 students' strategies of Solving the area and Volume of shapes

The question used to answer this section was designed to evaluate students' conceptual grasp of volume and surface area. It was specifically intended to confirm the fallacy that cubes in 3-D arrays can be wrongly counted and that 3-D objects can be mistaken for 2-D figures. For computational reasons, measurements were available just for Diagram 3b's dimensions. To assess whether students would correctly apply the unit squares and unit cubes presented at the beginning of the paper, the dimensions for the other two pictures were left out. Most participants believed that volume and surface area could never be obtained in situations where there were no specified dimensions (units). These findings seem to suggest that students might have been taught that volume and area are numbers that can be calculated using formulas (rectangle and prism) and this is their understanding of the concepts. Hence for the students without understanding on measurements, finds it difficult to explain how surface area and volume could be resolved without numerical values.

From table 1 above, only question 3b with dimensions had the highest percentage of right answers which are 28% correct and 10% partially correct. Thus, it is significant to note that falls within other side which are, 24% of the participants did not attend to the question at all. While 38% of participants gave some erroneous answers. And 17% of participants correctly identified the volume of diagram 3a when asked to find its surface area; however, they were unable to determine its surface area. Nonetheless, they all employed certain formulas. When a formula was not required, on this note, 45% of the participants employed one to determine the surface area and volume.

Even before the interviews, 14% of the participants clearly misunderstood the shape; they wrote that the shape lacked unit measurements, hence it could not have a volume or surface area, and this corroborate with them (Dogruer & Akyuz, 2020; Machaba, 2016). To clarify this statement, the best answer would have been to say that block 3a's surface area and volume could have been found by counting unit squares and unit cubes, respectively. The surface area was 56 square units, and the volume was 24 cubic units. Some participants correctly estimated the surface area, but none of them estimated the volume. Instead, most participants received a surface area of 64 square units. The inability to arrange cubes in arrays resulted in this eight square unit disparity. In response to the question in Question 3a regarding the surface area and volume of each block, participant Q3, as depicted in Figure 13, wrote the following:

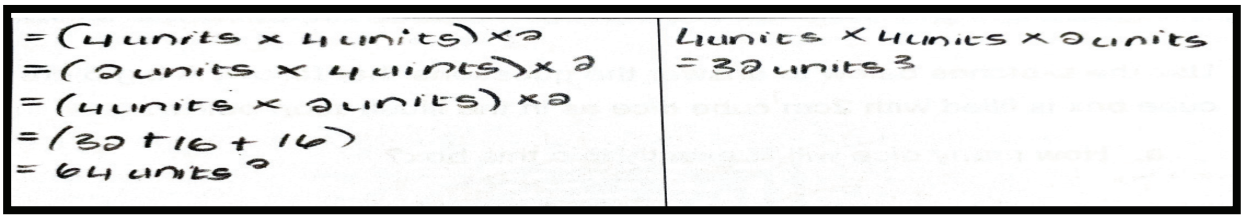


Figure 13: Participant Q3's response to Question 3a

Researcher: How did you find the surface area of this shape?

> *Participant Q3: I measured the height, length and width then multiplied by 2 to find the surface area.*

Researcher: Where are you trying to use any formula?

> *Participant Q3: I don't think so. What I know is that you would find how many are in the length, width and height and then calculate them using the calculation. Maybe length x 2; width x 2 and height x 2 then you add them all up together. Or you say length x width x breadth.*

The participant did not even know that using the wrong formula to multiply the length x breadth x height x 2 for the surface area was occurring. This leads to another common misunderstanding, which is explained in Dogruer and Akyuz (2020) conceptual framework: mixing up the formulas for volume and surface area. In this case, the participant switched the surface area formula for the volume formula.

Researcher: And for volume, how did you find it?

> *Participant Q3: I measured and calculated the three. There are 4 here (pointing at the edges of the shape), 4 here and 2 there, so l calculated then multiplied by 2 to find the volume.*

Researcher: Tell me why you multiplied by 2.

Participant Q3: For surface area, you always square.

Researcher: And for volume?

Participant Q3: It is the way you do it, and for the volume, you always put a 3 (referring to the cubic unit)

Participant Q3 understood the question and had some procedural knowledge, but not conceptual knowledge. It seems that participant Q3 has acquired instrumental knowledge regarding the process of utilising formulas to determine the volume and surface area of prisms. The learner's inability to explain the purpose and existence of the square and cube units for volume and surface area respectively, thus there is an evident of insufficient conceptual knowledge of the learners. The second most common mistake in this question was the idea that surface area and volume do not exist if there were no measurements, dimensions, or units. The written work of participants C3, G3, N3, and R3 demonstrated this. In response to the query regarding the volume and surface area of form 3a, participant C3, as depicted in figure 14, wrote as follows:

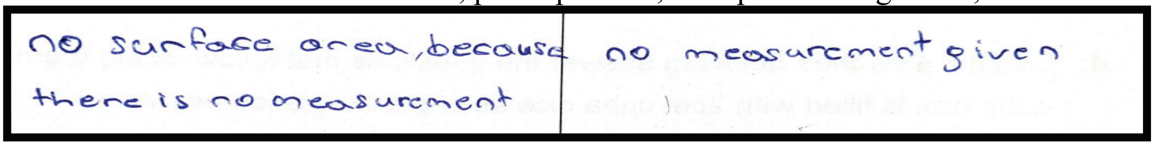


Figure 14. Participant C3's response to Question 3a

In support of this response during the interview, the following dialogue took place with the participant:

Participant C3: No measurements are given, so no surface area and volume.

Researcher: What measurements were you expecting?

Participant C3: The length, breadth and height.

Researcher: If you were given such, how would you have found the volume?

Participant C3: By saying length x breadth x-height.

Researcher: And for the surface area?

Participant C3: It is length x breadth + length x height + height x breadth

Researcher: How else can you find the surface area, without using the formula?

Participant C3: There cannot be another way. We always need the rule first.

It is evident that participant C3 first believed that volume and surface area could not be found in the absence of measurements. Participant C3 also linked surface area and volume to a formula or rule. Additionally, the learner offered a partial formula for calculating surface area. The answers in the snippet show some procedural understanding was found during the participants' understanding, but this is not enough conceptual knowledge. Response from table 1 indicates that 83% of the participants had either did not attempt to respond at all, indicating that they were not accustomed to determining the surface area and volume of questions like block 3a. The main fallacy in this question was that most participants thought the shape lacked a defined length, width, and height and was uneven, non-level, and incomplete (Machaba, 2016; Reader et al., 2021). The learners concluded that block 3a's volume and surface area were missing. Nevertheless, it was unclear from our data whether this was a course concept that required further development or a taught misunderstanding.

Grade 8 students' strategies of solving the three-dimensional objects

Since Question 3b was the only one with a view to probe the measurements in all three dimensions, therefore, calculations were required to support the result. Surprisingly, even though the participants were having trouble with the other diagrams, most students correctly calculated the surface area and volume of this design. Thus, one could argue that this resulted from the formulae's privileged show that a right rectangular prism was the shape that had used formulas to cover surface area and volume in earlier grades, which the students were already familiar with. Therefore, every participant who correctly used the formulas received the correct answer. More so, when working with 3-D shapes, surface area, and prism volume, this kind of diagram is most frequently utilised from the foundation phase through the intermediate and senior phases.

From the views of the participants, the appropriate response to this question was that it had volume since the contained shape took up space and had surface area because it had three pairs of opposite faces surrounding it. Given the dimensions, the participants would then compute as needed using the appropriate surface area and volume formulas, yielding a surface area of 548 square units and a volume of 720 cubic units. Out of all the participants that participated in this section, 24% correctly estimated both the volume and the surface area, 14% correctly calculated the surface area but not the volume, while 41% of the respondents answered this question incorrectly, and another 24% did not even try. This implies that most mistakes related to this issue were either applying the erroneous formula or the selected the formula incorrectly. A few individuals were only able to locate the faces' exposed surfaces. This mistake supported the second misconception of the poor conceptual understanding, which states that one should calculate the total volume or surface area rather than only counting the visible units or cubes.

Regarding the shape of the object as found in question 3b, the surface area and volume of the participant C3, as depicted in Figure 18, commented as follows:

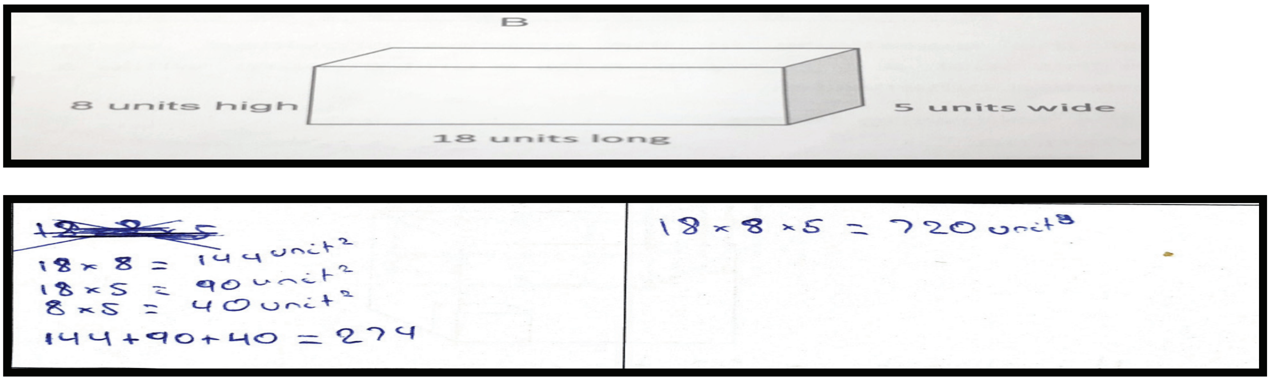


Figure 15: Participant C3's response Question 3b

When asked to motivate this response during the interview, participant C3 responded by saying that,

> *"I just calculated the surface area for the three sides and added them together because this shape has three surfaces, it is three-dimensional."*

Participant C3 demonstrated the effects of idea growth by introducing the formula through rote learning. The learner memorised the formula but could not tell the difference between the number of faces and dimensions. As a result, participant C3 did not include the invisible faces in the calculation; a misconception caused by inadequate mastery of concepts.
Participant H3 reported as shown in figure 16 below

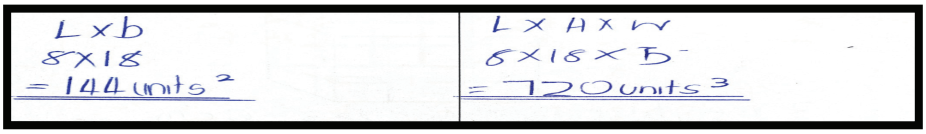


Figure 16: Participant H3's response to Question 3b

When asked to justify her responses, participant H3 said that,

> *"length x breadth. 8 units high and 18 long, so 8 x 18 = 144unit ² and for the volume, I multiplied using the formula...length x breadth x-height."*

The third misunderstanding, which had not yet been addressed, was pointed out by participant H3. It stated that the surface area of a 3-D figure was equal to the area of one of its 2-D faces. The written script submitted by participant A3 demonstrated the same logic. This conversation revealed that the participant mistook surface area for volume and had switched them around (Dogruer & Akyuz, 2020). However, it was determined that the participant had attempted to apply a formula that was difficult to understand.

Grade 8 students' strategies of solving the surface areas and volume in an examination question

This question combines the examination of surface area and volume conservation of space. Here, it was confirmed that some gaps in between the blocks in 3c exist, just like in the preceding questions in the surface area. The objective of this section was to determine if students could still calculate the volume by counting the cubic units used to construct the block and the surface area by counting the square units surrounding the shape. This section concentrates on how students in Grade 8 would react to the spaces inside the shape and whether those spaces were part of the volume, and table 1 shows that none of the participants answered this question correctly in every segment. Out of all participants, 10% gave somewhat accurate answers, 62% gave wrong answers, and 28% made no attempt at all to answer the question.

The construction of the surface area and volume was made of cube blocks with multiple faces, which is the proper response to question 3c. One may have determined the surface area by counting the square units surrounding each face. Thus, a total surface area of 216 square units was observed, with 36-unit squares on each face, therefore, one hundred and eight cubic units would have been the volume that would have been achieved by counting every unit cube that was utilised to construct the edifice.

It is this note that one could argue that 3% of the subjects had the right surface area but the wrong volume. Two, through the additional contributors provided explanations for the volume's existence. Additionally, three participants attempted to calculate the surface area and volume using a formula, but they encountered difficulties. This was the initial misunderstanding over this query.

Not only were there gaps in diagram 3c, but 14% of participants claimed that it lacked surface area and volume as well as length, breadth, and height metrics. According to 34% of the participants' written work, because 3c "had spaces, not regular, not consistent lines, not a fixed shape," it lacked both surface area and volume. That was the most common misunderstanding about this query.

Regarding Question 3c, participant A3, as depicted in figure 17, wrote the following:

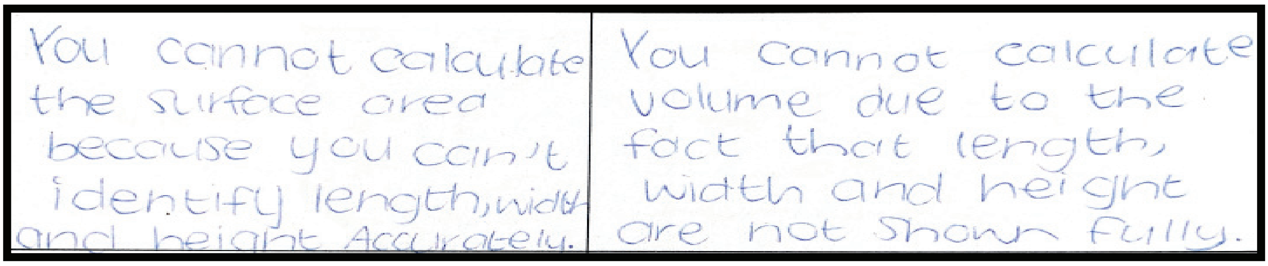


Figure 17: Participant A3's response to Question 3c

During the interview, participant A3 supported the written answer, arguing in the manner displayed in the following extract:

Researcher: In question 3c, how did you derive that one can't find the surface area and volume?

> *Participant A3: I saw that the shape is not definite, there are gaps in between.*

Researcher: How does a definite shape look like?

> *Participant A3: It must have a proper length, width and height, without all these gaps.*

Participant A3's comments in Question 3c were consistent with what was said in Question 2 about using a formula for any mathematical process.

Responding to Question 3c, participant G3, as shown in Figure 21, wrote that surface area and volume could not be found as the shape was "irregular." This is evident in the next script.

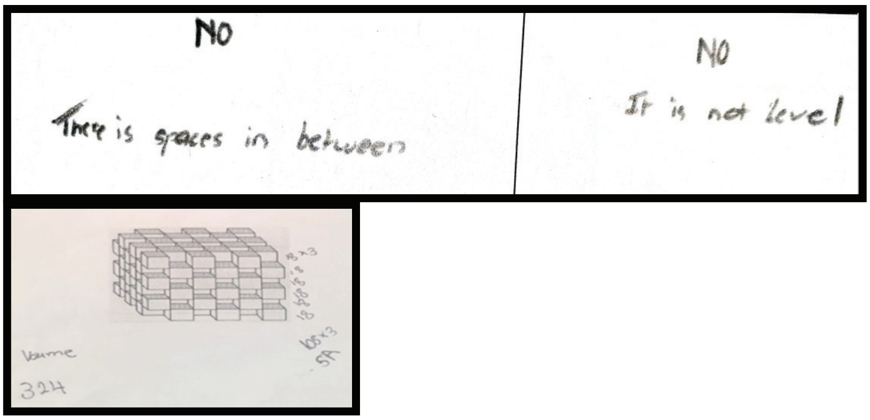


Figure 18: Participant G3's response to Question 3c

During the post-test interview, participant G3 gave the following explanation in defence of the assertion:

Researcher: How did you solve question 3c?

> *Participant G3: I said there are spaces in between, so no surface area. For volume, I also said no volume because it is not level.*

Researcher: What do you mean by the shape not being level?

> *Participant G3: There is no proper length, width and height, because of these spaces. I cannot use the formula.*

The student clearly expected the shape to be solid with measurements in precise units so that he could apply a formula to determine the surface area and volume. Participant G3 also confused the method for calculating the volume of a prism with the surface area before providing an inaccurate formula for volume.

Participant B3, as seen in Figure 22, wrote the following in agreement with the other discussed learners.

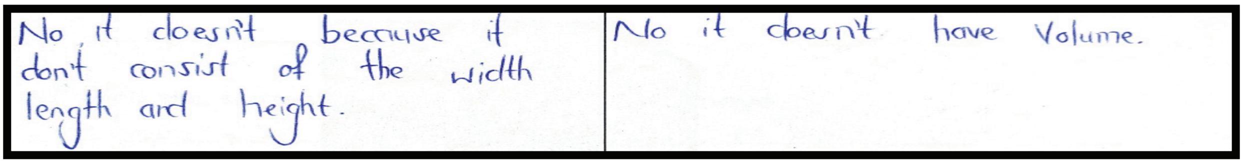


Figure 19: Participant B3's response to Question 3c

The most common misunderstanding regarding this subject was that the shape had too many spaces, making it impossible to calculate either the surface area or the volume. As with the previous shapes, most students still saw the shape as "incomplete, irregular, and inconsistent." On the other hand, liquid displacement can be used to find volumes of irregular forms. Other techniques for determining the volume and even surface area could have been applied if irregularity was the problem. For instance, students could have proposed covering the shape with a piece of fabric or paper and then calculating the surface area of the cover. The participants' weak knowledge of facts, skills, and concepts resulted in a lack of conceptual comprehension of surface area and volume, as shown by their responses.

Given the specific length, breadth, and height of the prism, Grade 8 students in this study found it easy to solve basic procedural issues involving surface area and volume of prisms, in addition to information recall (Machaba, 2016). As seen by the findings of Question 3b in Table 3, the students in this instance used the pertinent formula to solve the problems. Twenty-eight percent of the participants correctly calculated and answered test question 3b of this study, which included distinct dimensions and units. Even in cases when students utilised the proper formula to determine a prism's surface area, they were unable to clarify the rationale behind multiplying by two after determining the areas of faces that are visible in isometric pictures. They simply applied the formula without knowing its meaning, which is a misunderstanding that aligns with Dogruer and Akyuz (2020) and Van de Walle et al. (2016) reported that 39% of Grade 4 students confused the area formula with the perimeter formula. This conclusion was consistent with their findings. Additionally, it supports Chiphambo and Mtsi's (2021) assertion that learners encounter challenges related to prism volume and surface area. Regarding the surface area and volume square and cubic units, learners were unable to determine the origin of the symbols and insisted that they were only a component of the formula. This learner did not seem to understand that the relationship between the unit and what is being measured can be expressed using units of measure. For instance, the attribute volume could be quantified in terms of the quantity of units (cubes, balls, or cups of water to fill the bucket) in the context of volume and area. The number of index cards, squares of paper, or tiles needed to cover the object's surface could be used to quantify the attribute area.

These students do not appear to understand that measurement, in general, is comparing an item's attribute with that of a unit that shares the same property. For instance, lengths are compared to length units, areas to area units, and volumes to volume units. Additionally, when Grade 8 students were shown pictures with varying edge lengths and no units or dimensions, as in test item 3a, they had difficulty calculating surface area and volume, demonstrating instrumental understanding. Table 3 indicates that at least 83% of the participants answered that question incorrectly or did not try at all. Actually, because of the uneven, inconsistent, or irregular shape, students believed that surface area and volume could not be calculated. Furthermore, students were unable to identify the surface areas and volumes of prisms with gaps, as demonstrated by test item 3c, for which over 90% of participants either provided an inaccurate response or made no attempt to reply at all (Table 3). Students stated that holes in this problem excluded the shape from having volume and surface area. This misunderstanding was ascribed to inadequate linkages between new and pre-existing knowledge. This result is consistent with the research conducted by Machaba (2016), Patahuddin et al. (2019), and Makonye (2019), which discovered that students struggled to define the concept of area without resorting to the formula A = L x B. Most students could not describe area as a region's total surface area. According to several students' responses in Machaba's (2016) study, an irregular shape—like a leaf—does not have an area since it lacks length and width. This suggests that when given numbers to substitute, these students simply understand the method or procedural fluency of calculating area flexibly, accurately, and quickly.

Machaba (2016) discovered in his research that students could compute area when provided measurements, but they were unable to do so when the figure lacked measurements. They were unaware that measuring the square centimetres might be used to calculate the area. Their inability to connect the dots between the graphic with measures and the one with square centimetres suggests that they also do not have a mental grasp of area.

Conclusions

The findings of this paper had confirmed some errors and misconception from the learners' responses which are lack of vocabulary to identify ideas or describe processes involved in finding the volume or surface area, as well as insufficient mastery of abilities such as covering, packing, and filling. Furthermore, the study found that, in most cases, learners indicated that volume and surface area could only be determined when a quality of length is given. Thus, without the measurements (length, width, height), then surface area and volume could not be sought. This could be due to the way the learners were taught by the teacher, using a formula. Therefore, the inability of the learners to find the surface area and volume of irregular shapes could be because of their understand on these concepts. There is a need for further research into the way teachers introduce volume and surface area in the classroom.

Furthermore, the formulas for calculating the volume and surface area of prisms were overly generic to the point that they were utilised in lieu of definitions or descriptions. Therefore, most of the time, learners' knowledge of surface area or volume was restricted to formulaic applications. On this ground, the participants' overgeneralisation of abilities, ideas, and formulas was evident in their response way. Additionally, students occasionally made the incorrect association between volume and 2-D shapes. One student managed to provide evidence for the existence of a piece of paper's height (thickness). Pupils who understood the notion of volume correctly would have no trouble figuring out that volume was related to 3-D things rather than planar shapes like a rectangular piece of paper.

Recommendations

The following suggestions were recommended by the researchers:

- The researchers recommend that, the teachers should not be restricted to the introduction of surface area and volume on rectangular prisms and the formula alone but include surface area and volume of irregular real-life objects.
- We also recommend that instructors should refrain from using conventional teaching methods that involve lecturing and brainwashing students with the material. Furthermore, the use of physical manipulatives has a significant effect on learners' understanding of the surface area and volume of prisms, therefore rather than requesting learners to find surface areas and volumes of pictures of the prism, teachers can use practical activities like finding how much material can be used to cover or fill the classroom cupboard, one's bag, the dustbin or chalk box. Learners who have learnt in context would grasp material easily and with minimum room for misconceptions.

- The perceptions of the students shows that there are some low understandings of the students when learning the surface area and volume of some 2D and 3D objects, to improve on the level of understanding the teachers must re-orientate the students on the simple way of calculating surface area and volume of object without any delay.
- To further reduced the mistake and misconceptions developed by the students when learning surface area and volume, introducing a practical way of illustrating 2D and 3D remain important.
- The views of the students show that there are limited knowledge on the conceptual understanding of required procedure of learning surface area and volume, therefore, increasing learners conceptual understanding will be of assistance to them.

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