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THE VALUES LEARNERS CONSIDER AS IMPORTANT IN THE LEARNING OF MATHEMATICS

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ABSTRACT

Learners have different values that could affect their learning and eventually their performance in mathematics. However, many teachers are unaware of these values. Therefore, this paper reports on a study that established the values learners consider as important in the learning of mathematics. The participants were 274 Grade 9 learners, selected purposively from one school in Gauteng, South Africa. An exploratory quantitative research method was adopted and data were collected with a standardised questionnaire developed by Seah (2011b). The results revealed that learners value 1) Hard work and effort when doing mathematics; 2) Numerous different methods to obtain the answer to a mathematics problem; 3) Authentic examples of shapes to understand their properties; 4) Demonstration and explanation of mathematics concepts and proofs; and 5) Teaching and explaining mathematical concepts. This paper highlights the values teachers should consider in the teaching and learning of mathematics in order to ensure better learner performance in mathematics. Furthermore, the paper adds to research on values in Mathematics Education within a South African context.

Keywords: *learners; values; mathematics; learning*

1. INTRODUCTION

Worldwide there is a concern about the poor performance in mathematics at school level (Jerrim, 2015; Spaul, 2013). In particular, Simkins (2013), Spaul (2013) and Taylor (2011) claim that the performance in mathematics of the average South African Grade 9 mathematics learner is two years behind that of the average Grade 8 learner from other comparable middle-income countries, such as Botswana and Honduras. From 2012 to 2014 the average mathematics marks of Grade 9 learners have fluctuated between 11% and 13%, which besides being low, implies that schools are not producing the expected results (Department of Basic Education, 2014). Some of the reasons for poor performance include learners' poor work ethic, lack of motivation from teachers and non-completion of the syllabus within specified timeframes (Makgato & Mji, 2006; Schollar, 2015). Peng and Nyroos (2012) add that another



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factor that may potentially impact on the performance in mathematics is many teachers' unawareness of learners' values in mathematics. Seah, Andersson, Bishop and Clarkson (2016) consider values in mathematics as fundamental in facilitating effective learning and, as such, teachers should know what values are important for their students.

According to Seah *et al.* (2016:14), if learners' values are developed by "whatever sorts of beliefs, attitudes and interests they possess, [teachers] should be able to better facilitate a more positive and productive view of mathematics learning, and also a more empowering and relevant approach to curriculum reform". However, learners have different values that require different teaching methods to be used to cater for these different values (Peng & Nyroos, 2012). The idea of using the same teaching method for all learners of the same group should be reconsidered since the use of different teaching methods might improve the learners' understanding of mathematics concepts (Peng & Nyroos, 2012).

Seah (2016) argues that learners who value achievement in mathematics overcome most barriers to success and seem to better understand and remember the mathematics concepts they value. The values that learners subscribe to, relate to their conceptual understanding of mathematics (Seah, 2013), but also provide learners with the motivation and determination to work diligently in mathematics classrooms (Seah *et al.*, 2016). Values, such as working hard and putting in effort when doing mathematics, may cognitively affect learners' levels of reasoning and intellectual capacity, while values, such as appreciation for the usefulness of mathematics in real-life, may effectively contribute to learners' emotional experiences and/or motivation in learning mathematics. Seah *et al.* (2016) include that if learners are supported in appreciating what they value, it will encourage more positive and profitable learning of mathematics and might enable a significant approach to educational curriculum change. Therefore, what learners value as important in the learning of mathematics could impact directly on their learning of the subject.

This paper reports on a study aimed to establish the values that Grade 9 learners from a public school in Gauteng, South Africa consider as important in the learning of mathematics. A better understanding of learners' values could assist teachers to infuse values in their pedagogies to teach mathematics, which may lead to a better performance in mathematics.

Studies on values in the learning of mathematics are mostly limited to countries external to the African continent, such as Australia, Asia and Turkey (Seah, 2011a). Australian learners value memorising mathematical facts and shortcuts to solving a mathematical problem. Learners in Hong Kong and Malaysia value achievement, which motivates them to work hard to achieve their intended goals. Learners from Turkey are expected "to grow as citizens who embrace, protect and improve the Turkish nation's national, ethical, humanitarian, spiritual and cultural values" (Dede, 2011:605). Despite much research on the reasons underlying poor performance in mathematics (De Matthews, 2016; Makgato & Mji, 2006; Masekoameng, 2014), the researcher could not find any pertinent studies on learners' values associated with mathematics learning that has been conducted in South Africa. The authors of this study argue that if teachers could identify what values learners view as important in their learning of mathematics, they will be able to align these values according to mathematics education aspects, which, in turn, could lead to better performance in mathematics. Therefore, this paper could add to the body of literature on learners' values, with specific reference to the South African context. Thus, the research question arising is: What values do Grade 9

mathematics learners from a public school in Gauteng, South Africa consider as important in the learning of mathematics?

In the following sections, values in the learning of mathematics will be defined and motivated, followed by a discussion on the main theoretical underpinnings on values-based studies. Thereafter, the research methodology utilising a quantitative research approach will be outlined, followed by a discussion on findings from the data analysis process.

2. VALUES IN MATHEMATICS

Values refer to choices about what one regards as important, such as freedom to choose, having alternatives to choose from, as well as choosing after keen thought of the results of each option, prizing and appreciating (Raths, Harmin & Simon, 1987). Chin and Lin (2001) agree that values are preferences of individuals related to their personal standards of thoughts and actions that are important and worthwhile to themselves. In particular, mathematics educational values are connected to the teaching and learning of mathematics and refer to the degree to which standards and procedures that can be associated with teaching and learning of mathematics are viewed as important (Sam & Ernest, 1997). Bishop (1996) adds that mathematics education values are deep affective qualities that education aims to put into effect through engagement in mathematics. These values are reflected in the views that an individual has believed as being important and worthwhile for their learning of mathematics (Seah & Andersson, 2015). Therefore, for this paper values are defined as something important to a learner and worth doing.

The importance of values in the learning of mathematics is foregrounded in this paper since values influence the way learners choose to engage with mathematics tasks (Peng & Nyroos, 2012). Askew, Hodgen, Hossain and Bretscher (2010) found that good performance may be much more closely connected to learners' values than to particular arithmetic instructing practices. Valuing provides an individual with the will and determination to work in mathematics, as learners tend to engage in mathematics tasks they value (Seah, 2013). Values improve learners' conceptual understanding, thus maximising learners' learning (Seah, 2013). Values are dynamic and they do not have the same meaning for everyone as learners' values differ (Peng & Nyroos, 2012). When values are incorporated into the learning of mathematics, different approaches to teaching have to be employed depending on what the learners value (Dede, 2009). Therefore, different teaching methods must be employed to cater for learners with different values.

According to Seah (2013), learners who value achievement, work hard and succeed. Therefore, appropriate valuing might arm learners with a powerful force to overcome barriers to success. If learners have negative attitudes about mathematics, but they value achievement, this valuing will give them the determination to do well in mathematics (Seah, 2013). Learners understand and remember the concepts they value more than what has been taught to them in class (Bishop, 1999). Seah (2013) advises teachers to incorporate that what learners value in the learning of mathematics as it will improve conceptual understanding, thus maximising learners' learning. Incorporation of learners' values might in turn enhance learners' performance in mathematics.

Most studies incorporating values in the learning of mathematics have been conducted in countries such as Malaysia, Japan, Turkey, Asia and Australia (Seah, 2011a). Sam and Ernest (1997) conducted a research study in Malaysia to explore the values contained in the Malaysian

mathematics curriculum and revealed that values on “effectiveness, responsibility, self-discipline and appreciation of the importance and beauty of mathematics” are emphasised (Malaysia Curriculum Development Center, 1993:2). In addition to the curriculum analysis, teachers using this curriculum added that persistence, patience, punctuality and discipline might make learners develop good behaviours, which could lead to better mathematics learning.

According to Stigler and Hiebert (1999), Japan’s mathematics teachers value a flexible approach, which allows a learning environment filled with disruptions, discussion and new ideas. Ueda, Baba and Matsuura (2014) conducted another study on values in Japanese mathematics education and found the use of an open-ended approach that values learners’ mathematical thinking. Learners are allowed to work individually in order to build mathematical ideas in the lesson (Ueda *et al.*, 2014).

A research study by Dede (2011:609), with 107 randomly selected pre-service primary mathematics teachers enrolled at Cumhuriyet University in Sivas, Turkey, revealed that these teachers valued developing learners as citizens who embrace, shield and improve the Turkish nation’s national, ethical, humanitarian, religious and cultural values. This value is similar to the South African curriculum, where emphasis is placed on access, equity, redress and being a critical citizen (Masekoameng, 2014). However, Dede (2011) found that mathematics in Turkey is taught without relating the mathematical content to daily life. The textbooks and mathematics syllabi are incorrectly presented as value free. The research further revealed that mathematics achievement of Turkish learners is at a very low level compared to other countries where research on values was carried out.

Seah and Wong (2012) conducted research in East Asia to harness relevant values in mathematics pedagogy and found that learners from the region valued achievement that pushed them to work hard to achieve their intended goals. Mullis, Martin and Foy (2008) also revealed that although many Asian learners fear and even hate mathematics, they perform well in the subject and thus value achievement. Asian learners value achievement much more than they hate or dislike the subject.

Seah and Bishop (2000) conducted a study in Singapore and Australia where they studied lower secondary mathematics textbooks. They found that textbooks in both countries value teaching mathematics using routine drill questions. As a result, most of the textbooks test learners’ knowledge and memorisation.

Seah and Barkatsas (2014) conducted a research study focusing on what primary school learners from Australia value in mathematics learning. The sample consisted of 63 grades 5–6 learners in a single Catholic school in suburban Melbourne, Australia. They found that these learners value memorising of mathematical facts and shortcuts to solve mathematical problems. They also value knowing the stages of the solution that are formulated to get the answer and knowing the multiplication tables. Furthermore, these learners value the use of calculators, understanding the concepts they are learning through examples, and being able to analyse if the solutions are correct or wrong. Finally, they found that these learners value teachers who pose questions to them while providing individual help and feedback, and allow them to complete mathematical tasks individually and to know the importance of examinations and tests.

One of the few studies in Africa, conducted in Ghana, examined what learners intrinsically and extrinsically value. The sample consisted of 1 256 learners from 18 primary and secondary

state schools across urban and rural settings in the Cape Coast Metropolis of Ghana (Seah, Davis & Carr, 2017). Learners in Ghana value “achievement, relevance, fluency, authority, resourcefulness, learning environment, strategies, feedback, communication, fun, connections, engagement, applications, and accuracy in their mathematics learning” (Seah *et al.*, 2017:1). The values appear to be more extrinsic than intrinsic to the mathematics discipline, which imply they value things that are not really mathematically related.

The countries mentioned above had similar learner values such as effectiveness, self-discipline and achievement. Teachers in Japan value learning that promotes higher order thinking while teachers in Singapore and Australia promote routine drill questions and memorisation. Learners in these countries value working individually and memorisation respectively.

3. THEORETICAL UNDERPINNINGS

The two theoretical underpinnings for the study this paper reports on are the value theory in Mathematics Education of Bishop (1996) and Seah's (2011a) five value dimensions. Bishop (1996) classified values taught in mathematics lessons into three kinds, namely general educational values, mathematical values and mathematics educational values. First, general educational values are not subject-related concepts, but include values such as good behaviour, honesty, respect, humanity and humility. Secondly, mathematical values are the values that mirror the type of mathematical knowledge and are shaped by mathematicians who have grown up in different cultures, such as rules, conjectures or inferences. Lastly, mathematics education values connect the pedagogical approaches and norms of teaching. For example, some teachers might value showing all working out when answering questions and not to rely on a calculator when doing calculations.

Bishop (1999) classifies mathematical values taught into three categories. Firstly, *rationalism/objectism* refers to the values that learners have about mathematics. “Rationalism elaborates on correctness of results and explanations, while objectism value shows objects and symbols which is an instrument to concretize mathematics that has an abstract language” (Dede, 2011:86). Secondly, *control/progress* is open to development and can be used in other subjects in school lessons. Control involves forming rules or conjectures. Progress incorporates generalising. Lastly, *openness/mystery* is revealed when deliberating and analysing mathematical concepts, thoughts, outcomes and influences. Asking learners to explain their ideas to the whole class is a good way of developing openness. On the other hand, mystery indicates how wonderful and surprising mathematics can be. This paper focuses specifically on these mathematics education values.

The second theory underpinning this study is Seah's (2011a) five value dimensions, namely relevance, accessibility, formalistic view, relational view and process (tool or procedure). According to Dede (2011), relevance implies values where learners can solve everyday issues and make more brilliant ways through which the society develops. Accessibility indicates the values focusing on doing and preparing of mathematical activities by everyone or just by people with the talent to execute them. The formalist views mathematics learning as including consistent thinking and pleasant learning, whereas the extremist sees mathematics learning as including natural thinking and discovery learning (Dede, 2011). A relational view refers to values associated with learning of rules, procedures and formulae, while process implies the use of a tool and a procedural view of mathematics learning (Seah, 2011a).

Seah’s (2011a) five value dimensions are related to Bishop’s (1996) five mathematics educational values. Relevance view is equated to progress–control dimension; accessibility view to openness–mystery dimension; formalistic view to explanation–exploration dimension; relational view to recalling–creating dimension whilst process (tool or procedural) view is equated to process–product dimension.

These two underpinnings support the view that values provide the individual with the will and strength of character to maintain any development chosen in the learning and teaching of mathematics. These theoretical underpinnings endorse good behaviour, honesty and respect; reflect the nature of mathematical knowledge; and attribute success to effort and excellence of the teacher.

4. METHOD

An exploratory quantitative research method was used to collect data. The data collection instrument was a standardised questionnaire developed by Seah (2011a). The instrument comprised ten (10) semantic differential items where participants had to tick one of the blocks to indicate if phrase A was more important to them in the learning of mathematics than phrase B, or vice versa. If a participant placed a tick in the middle block, this would mean that phrases A and B were equally important to the learner. Table 1 represents an example of an item in the questionnaire.

Table 1: Example of a semantic item

Number	Phrase A	-2	-1	0	1	2	Phrase B
1	Leaving it to <i>ability</i> when doing mathematics	X					Putting in <i>effort</i> when doing mathematics

Two hundred and seventy-four Grade 9 learners were purposively and conveniently selected from a public school in Gauteng, South Africa. It was convenient since the researcher is teaching at the same school under study. Participants agreed to participate voluntarily and were from a school where many learners experience challenges with mathematics learning. All participants’ home language was English, which made it easy for them to understand and respond to the items in the questionnaire, which had been developed in English. The biographical information was analysed according to age, gender, race, home language and learners’ views on their mathematics achievement.

Data were collected by means of a printed version of the standardised questionnaire. Two hundred and fifty-six participants of the 274 Grade 9 learners, grouped in nine Grade 9 classes, completed the questionnaire within 30 minutes over a period of two weeks during school hours.

Reliability for the data collection instrument used in this study was mainly confirmed by previous studies. One of the studies in Africa, conducted in Ghana by Seah *et al.* (2017), obtained a Cronbach alpha value of 0.947, whilst a study done in Japan by Shinno, Kinone and Baba (2014:172) “yielded satisfactory Cronbach’s alpha values for each of the five factors, ranging from 0.772 to 0.936”. Although the researcher employed a reliability analysis using the Cronbach alpha coefficient, the strength of association was poor (Cronbach α = 0.253).

Pallant (2007) acknowledges that it is common to get a low degree of internal consistency for small samples, especially if constructs consist of less than ten items. Therefore, inter-item correlation was performed as an additional test of reliability to determine whether they fitted the optimal recommended range between 0.20 and 0.40, as displayed in Table 2.

Table 2: Inter-item correlation for the ten semantic differential items

Component for inter-item correlation	Mean	Minimum	Maximum	Range	Number of items
Item means	3.079	1.949	4.191	2.242	10

Content validity was ensured by using a standardised questionnaire, called What I Find Important (WIFI) in Mathematics Learning, designed by Seah (2011a). This questionnaire was validated by various research teams from different countries, such as Australia, Brazil, China, Hong Kong, Malaysia, Japan, Singapore, Sweden, Taiwan, Turkey and the United States in 2012 (Seah *et al.*, 2016). To ensure face validity, 36 learners were randomly selected to participate in a pilot study prior to the actual study to rectify any vague questions in the data collection instrument that learners might not understand. Face validity was also ensured by requesting content experts and colleagues to check if the data collection instrument represented what it was expected to measure and to identify items that lack clarity or that may not be appropriate for the information needed for the study.

Ethical clearance was obtained from the University of Johannesburg's Faculty of Education Ethical Committee (clearance number 2017-100) and from the Gauteng Department of Education before any empirical work was conducted. The principal of the school, parents and learners also gave consent and all ethical measures were adhered to.

5. RESULTS

Data pertaining to the responses on the ten (10) semantic differential items were analysed with assistance of a software program, namely the Statistical Package for the Social Science (SPSS), version 23, using descriptive statistics methods, such as frequency analysis cross tabulations. The percentage response for each phrase on what values participants consider as important in the learning of mathematics is presented in Table 3. Table 3 also presents the mean and standard deviation of each phrase. The negative values -2 and -1 in Table 3 imply that participants value the phrases listed on the left side more than those listed on the right-hand side in the questionnaire, but also the opposite direction applies. The positive values 1 and 2 imply that participants value the phrases listed on the right-hand side more than those on the left-hand side.

Table 3: Descriptive statistics pertaining to what values participants consider as important in the learning of mathematics

Statements	-2 Phrase A Strong	-1 Phrase A Mild	0 Neutral	1 Phrase B Mild	2 Phrase B Strong	Mean	Standard deviation
How the answer to a problem is obtained versus what the answer to a problem is.	87 37.3%	38 16.3%	66 28.3%	24 10.3%	18 7.7%	-0.65	1.285
Feeling relaxed or having fun when doing mathematics versus hard work is needed when doing mathematics.	29 12.0%	25 10.3%	65 26.9%	44 18.2%	79 32.6%	0.49	1.355
Leaving it to ability when doing mathematics versus putting in effort when doing maths.	3 1.2%	20 8.2%	23 9.5%	63 25.9%	134 55.1%	1.26	1.013
Applying mathematics <i>concepts</i> to solve a problem versus using a <i>rule</i> or <i>formula</i> to find the answer.	27 11.2%	19 7.9%	89 36.8%	25 10.3%	82 33.9%	0.48	1.327
Truths and facts, which were discovered versus mathematical ideas and practices used in life.	26 10.9%	37 15.5%	69 28.9%	64 26.8%	43 18.0%	0.26	1.232
Someone teaching and explaining mathematics to me versus exploring mathematics by myself or with friends.	135 55.3%	42 17.2%	41 16.8%	9 3.7%	17 7.0%	-1.10	1.221
Remembering mathematics ideas, concepts, rules or formulae versus creating mathematics ideas, concepts, rules or formulae.	99 40.4%	59 24.1%	49 20.0%	20 8.2%	18 7.3%	-0.82	1.251
Telling me what a triangle is versus letting me see examples of triangles to understand their properties.	12 4.9%	10 4.1%	31 12.7%	59 24.1%	133 54.3%	1.19	1.115
Demonstrating and explaining mathematics concepts and proofs versus keeping mathematics magical.	103 42.2%	66 27.0%	46 18.9%	14 5.7%	15 6.1%	-0.93	1.115
Using mathematics to predict or explain events, for example, staying in control versus using mathematics for development and progress	12 5.0%	19 7.9%	88 36.4%	47 19.4%	76 31.4%	0.64	1.148

The values, as stated by the semantic differential items, were aligned with those values identified by Bishop (1999) and Seah (2011a) and illustrated according to their mean values as indicated in Figure 1. Furthermore, the values were categorised either as intellectual (Items 1, 3, 7 and 10) or emotional (Items 2, 5, 6, 8 and 9). Items 1, 2 and 4 were negatively worded and the order was reversed.

6. DISCUSSION AND INTERPRETATION OF RESULTS

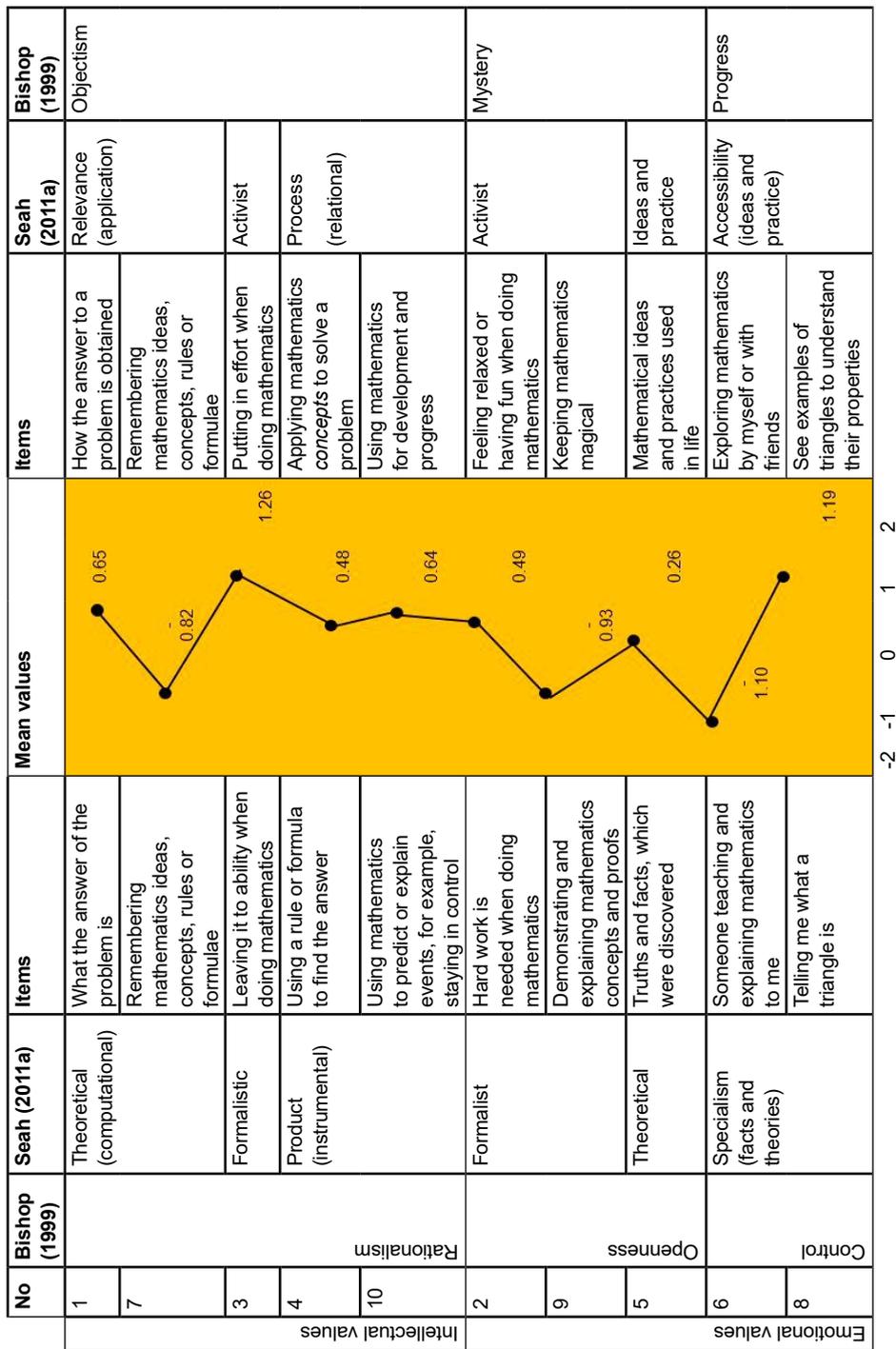
The discussion of the results should be interpreted with caution as the results are trends emerging from the particular context of this study and not pertinent findings that can be generalised. From Figure 1 it can be deduced that the intellectual values of participants tend to focus more on the application and process of mathematics, than on theoretical and procedural knowledge. However, memorisation of mathematics concepts and rules are also valued. This finding is aligned with Seah *et al.* (2016) noting that practising mathematics may affect learners' cognitive capabilities.

Slightly more than half of all participants ($n = 125$; 53.6%) valued how the answer to a problem is obtained ($M = 0.65$, $SD = 1.285$) over what the answer to a problem is ($n = 42$; 18%). According to 63 Grades 5–6 learners in a Catholic school in suburban Melbourne, Australia, achievement is possible if one knows the steps of the solution (Seah & Barkatsas, 2014). Knowing the steps to a solution might lead to the understanding of the concepts learners are learning, and their ability to analyse mathematics problems if the solutions are correct or incorrect. These steps of getting a solution may be achieved if one values mathematical ideas and practices used in life.

Many participants ($n = 158$; 64.5%) valued remembering mathematics ideas, concepts, rules or formulae ($M = -0.82$, $SD = 1.251$) over creating mathematics ideas, concepts, rules or formulae ($n = 38$; 15.5%). Alike to this finding, Seah and Bishop (2000) found that textbooks in Singapore and Malaysia value teaching mathematics using routine drill questions. As a result, most learners tend to resort to memorisation in order to remember the formula instead of generating mathematics understanding. This finding could have transpired because of learners not being critical thinkers who could solve problem solving questions on their own, but who require the provision of step-by-step calculations.

Most of the participants ($n = 197$; 81%) valued putting in effort when doing mathematics ($M = 1.26$, $SD = 1.013$) compared to leaving it to ability when doing mathematics ($n = 23$; 9.4%). According to Schollar (2015), good work ethic will result in learners putting in effort when learning mathematics. Therefore, it could be derived

Figure 1: Semantic differential items on values aligned with those of Bishop (1999) and Seah (2011a)



that it is not only a person's ability that predicts good mathematics results, but it is about putting in effort when doing mathematics.

Slightly less than half of the participants ($n = 107$; 44.2%) valued using a rule or formula to find the answer ($M = 0.48$, $SD = 1.327$) rather than applying mathematics concepts to solve a problem ($n = 46$; 19%). According to Seah and Barkatsas (2014), 63 Grades 5–6 learners in a Catholic school in suburban Melbourne, Australia believed achievement was possible if one knows which formulae to use to arrive at the solution and know the multiplication tables. This finding could be a result of learners' inability to use the correct formula that leads to wrong calculations and a possibility of misunderstanding the concepts.

Almost half of the participants (50.8%, $n = 123$) valued using mathematics for development and progress ($M = 0.64$, $SD = 1.148$) compared to using mathematics to predict or explain events, for example staying in control ($n = 31$; 12.9%). Mathematics concepts enable learners to develop the ability to deal with mathematical challenges of daily life and to progress with their study of mathematics in high school and beyond (Kilpatrick, Swafford, & Findell, 2001). This study is similar to the findings from Ueda *et al.* (2014) who revealed that learners value mathematical thinking when they have been allowed to work individually to build mathematical ideas in the lesson. This skill to think critically and to work independently might allow learners to be able to deal with any mathematical challenges in real life.

Evident from Figure 1, participants for this study tend to have a mix of emotional values regarding the appreciation of the nature of mathematics and motivation to do mathematics. Although they are likely to enjoy doing mathematics, the participants lean towards teachers to explain the mathematics to them by means of practical examples. This finding aligns with Seah *et al.* (2016) claiming that valuing the usefulness of mathematics in real-life may add to learners' emotional feelings and motivation in doing mathematics.

About half of the participants ($n = 123$; 50.8%) valued that hard work is needed when doing mathematics ($M = 0.49$, $SD = 1.355$) over feeling relaxed or having fun when doing mathematics. This finding is similar to Seah and Wong (2012) who found that some learners from two Asian countries, namely Hong Kong and Malaysia, valued achievement that push them to work hard to achieve their intended goals. This finding was made after Seah and Wong (2012) had identified and had discussed the values espoused by learners and their teachers when mathematics had been learnt particularly effectively (from the learners' perspectives) in Hong Kong classrooms. This finding can be interpreted that for one to succeed in mathematics one has to work hard.

More than half of the participants ($n = 169$; 69.2%) valued demonstrating and explaining mathematics concepts and proofs ($M = -0.93$, $SD = 1.115$) than viewing mathematics as magical (like a dream or supernatural subject) ($n = 29$; 11.8%). If teachers are mathematically proficient, they are able to explain mathematical concepts to learners, carry out procedures flexibly, accurately and guiding learners to see mathematics as sensible (Kilpatrick, Swafford, & Findell, 2001). This finding is similar to a study by Stigler and Hiebert (1999), who revealed that Japan's mathematics teachers value a flexible approach that allows a learning environment filled with disruptions, discussion and new ideas. This finding could be interpreted as follows: If teachers demonstrate and explain mathematics concepts well, learners might see mathematics as sensible and worth doing, as this might result in a clear understanding of what is being taught.

In addition, less than half of the participants ($n = 107$; 44.8%) valued using mathematical ideas and practices used in life ($M = 0.26$, $SD = 1.232$) compared to participants valuing truths and facts that they discovered ($n = 67$; 26.4%). Similar to this finding, Ueda, Baba and Matsuura (2014) found that learners from Japan value constructing mathematical ideas in the lesson, which implies learning mathematics does not rely only on discovered facts, but facts used in a real-life context. This finding could be derived from learners tending to understand and remember concepts they see in real life.

Almost three quarters of the participants ($n = 177$; 72.5%) valued someone teaching and explaining mathematics to them ($M = -0.10$, $SD = 1.221$) over exploring mathematics by themselves or with friends ($n = 26$; 10.7%). This finding is comparable to Seah and Barkatsas (2014), who found that learners from Australia value teachers who pose questions to them whilst providing individual explanation, help and feedback. In line with this finding, we have seen as practitioners that there are learners who understand better when mathematics concepts are explained to them than when they have to learn these concepts by themselves.

A considerable number of participants ($n = 192$; 78.4%) valued seeing examples of shapes to understand their properties ($M = 1.19$, $SD = 1.115$) over the teacher telling them what a shape is ($n = 22$; 9%). This is similar to the findings from Ueda, Baba and Matsuura (2014) who found that learners from Japan value constructing mathematical ideas in the lesson, which implies learning mathematics does not rely only on discovered facts, but facts used in a real-life context. Seeing real-life models of shapes provide relevance to learners' learning, while giving them an opportunity to connect their world to classroom mathematics (Riley, 2012). Some learners might even understand mathematics better, simply because of seeing authentic examples of the concept being taught at that moment (Vanada, 2011).

In summary, almost half of all participants valued how the answer to a problem is obtained over what the answer to a problem is. The same applies to participants valuing hard work when doing mathematics over feeling relaxed or having fun when doing mathematics. The last finding shows that learners realise that in order to succeed in mathematics learning, one has to work hard through practise, ask questions, do homework and concentrate in class.

According to the findings, it could be derived that if learners value working hard, they will put in effort when doing mathematics instead of only relying on their ability when doing mathematics. Most participants value using mathematical ideas and applications in real life, rather than valuing truths and facts, which they have discovered. Almost three quarters of the participants valued someone teaching and explaining mathematics to them over exploring mathematics by themselves or with friends. From the findings, it can be derived that learners rather value remembering mathematics ideas, concepts, rules or formulae than creating mathematics ideas, concepts, rules or formulae. However, as 21st century mathematics teachers, we should enforce skills such as creativity, critical thinking, collaboration, communication and problem solving.

7. CONCLUSION

Poor performance in mathematics at school level is a concern in many countries. A possible reason for poor performance could be that teachers are ignorant about what values learners consider as important in the learning of mathematics. The identification of values that learners view as important in their learning of mathematics could assist in categorising these values according to mathematics education aspects, which, in turn, could lead to better performance

in mathematics. Therefore, this paper reported on a study that established these values that Grade 9 learners from a public school in Gauteng, South Africa consider as important in their learning of mathematics.

This study revealed that learners have various values that they associate with mathematics learning. Most participants value how the answer to a problem is obtained and hard work and effort when doing mathematics. Some participants valued someone teaching and explaining mathematics to them, and the remembering of mathematics ideas, concepts, rules or formulae. Lastly, learners tend to value the learning of mathematics when teachers let them see real-life examples of shapes to understand the properties and when teachers demonstrate and explain mathematics concepts and proofs to them.

One limitation of the study reported in this paper was that the researcher only used ten semantic questions to determine what values learners consider as important in mathematics. Unfortunately, the extent to which these values relate to learners' performance in mathematics was not determined. The localised nature of the study applicable to one single school in Gauteng, South Africa, also prevents the generalisation of the results to other contexts. Therefore, it is recommended to expand this study to more types of schools, to various grades and to different contexts. Further studies could also include the values that teachers find important in the teaching of mathematics.

Values influence the way learners choose to engage with mathematical tasks, and eventually how they will perform in the subject. Therefore, mindfulness by teachers about what values learners consider as important in their learning of mathematics, afford teachers the opportunity to use pedagogical approaches that will include these values. The findings of the study reported in this paper add to the international body of research on values in mathematics and specifically in the context of South Africa.

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