RESEARCH ARTICLE

Creating an Environment for the Restoration of Dignity to Disadvantaged Mathematics Foundation Classrooms

Zingiswa Jojo

Department of Mathematics Education, University of South Africa, Pretoria, South Africa

Abstract: This article chronicles how a conducive environment creates a restoration of dignity to disadvantaged mathematics foundation learners. The variation theory was used to provide the sequential building blocks required to learn foundation mathematics to Grade 1–5 learners in a district in the Eastern Cape province of South Africa. A sample of 23 learners participated in this study. Structured worksheets covering mathematics content for Grade 1–5 were prepared for the learners to practice after school in a homework club on their own, in rural settings in a study that followed qualitative methods. Results indicated how the creation of a supportive and caring environment developed the learners' resilience, restored their dignity and increased their competence in an understanding of basic mathematics concepts. The learners also developed good relationships with each other while they shared information and helped others to restore their dignity and led them ultimately to the independence of acquiring other mathematical skills and ownership of the learning experiences. The intervention with the after-school program may serve as a suitable environment for the disadvantaged learners and restore their competence in understanding mathematics concepts while providing a platform for learners to share knowledge gained with the underprivileged ones.

Keywords: Mathematics; Environment; Dignity; Learning; Concepts

1. Introduction

1.1. Text

When a child misses one procedural step in a mathematics lesson, it becomes impossible for him/her to understand what comes next in other lessons. Mighton[21] asserts that learners who do well in mathematics are much more likely to finish school, attend university, and earn good living than learners who struggle in the subject. While mathematics is a strong predictor of academic success, children who attend dysfunctional schools without qualified mathematics teachers incur achievement gaps that impose the equivalence of a permanent national recession on a country's economy.

Jeanty[10] asserts that sociological studies show the effects of poverty as being passed down from generation to generation. Consequently, stressful conditions within the home environment tend to be prone toward ineffective communication patterns, which serve to further hamper the child's ability to communicate within the classroom. In South Africa, Timaeus *et al*.[29] noted that although great progress has been made in enrolling children into school at the appropriate age, there remains differentials in school grade progression by race and geographical areas in South Africa. This disparity, therefore, suggests that South African school policy must develop complementary strategies to change the existing restricting environments of the country. These authors note failure by the government to ensure consistent acceptable standards in rural schools with respect to lack of basic facilities and poor teacher training resulting in ineffective teaching techniques to

doi: 10.18063/esp.v3i2.695

perform high quality work in trying conditions. Consequently, poverty continues to hold back children's progress at school in South Africa and in particular, the inter-related effects of socioeconomic status, race, and environment are escalating.

Spaull[28] avers that children in most Eastern Cape schools in South Africa fall further and further behind the curriculum leading to a situation where remediation is almost impossible in high school since the learning gaps in mathematics were unaddressed for too long. Gaps in mathematics content knowledge, leave children wanting, and deprived of understanding this subject as they move to higher levels of instruction. Since this subject is a pre-requisite to enroll for prominent careers such as medicine, architecture, engineering, economics, and other fields in the country, the implication is that very few learners from underprivileged schools remain mathematically competent enough to access those careers.

The construction of mental representations of the direct experiences relevant to a particular concept in mathematics is essential for learners to obtain mathematical meaning. Constructivists[2,3,6,24,30] assert that children learn by building or constructing their own knowledge by integrating new concepts and procedures into existing mental structures. This article reports on a research conducted with children in impoverished community whose life possibilities are far from reaching the promises of globalized mathematics discourses and of social and economic democracy. It is an attempt to illustrate how the mathematics knowledge gap created in the classroom due to absence of trained qualified facilitators deprives restoration of dignity to affected learners. I start this article by formulating the poverty cycle which learners find themselves in most rural schools and how their dignity as beings is challenged in mathematics classrooms. I then address the issue of how children in under developed schools environment are compromised on dignity, self-respect, and freedom to think critically. I then present the theoretical notions of variation on which I constructed the meaning of space and shape when working with primary school children in lower grades. Other related discursive fields were used for the intervention program to help learners make meaning of space and shape in their surrounding environments. Lebech[15] defines dignity as what is proper to the kind that "one" is or to the species of rational humanity. In particular, it refers to that which in a personal being induces or ought to induce respect, its excellence or incomparability of value, the quality of being worthy of esteem or respect. The author further notes that the building of character in a human being occurs when the integration of physicality and personal experience in a unity is accounted for in reason. The detachment where learners cannot identify with other learners and with their role in the immediate environment disadvantages them in displaying their abilities to the utmost, and knowing who they are as individuals. It is only when learners identify with what lies beneath or supports their nature and immediate environment, their reasoning ability and social integration that they open up the depths of their personality. The creation of meaningful learning experiences for learners allows both learners and teachers to experience the mathematics classroom as a place of engagement, deeper meaning, and discovery. In that engagement, learners get to know that they are valued as people and that their teachers care about their well-being and not just their grade, and these results in a shift of the classroom dynamics. In addition, some researchers note that learners need to know that using their imaginations in meaningful ways are critical to their education and ultimately, and their lives. Thus, teachers need to emphasize relationships more than compliance and prioritize learners' voices in a mathematics classroom while they ensure that learners' concept abstraction is activated.

The legacy of poverty and neglect in most rural schools is far from being eliminated, partly due to the emphasis in South Africa is on urban development. Gardiner[7] argues that the achievement of real quality in education in rural areas in South Africa can only come about when there is significant social and economic development in those areas. Much often, classrooms in the foundation phase are under the instruction of less informed or unqualified mathematics teachers. Until that problem is addressed, the education provided in under-developed areas will limit learners' opportunities to lead long, healthy and creative lives, or to acquire knowledge and enjoy freedom, dignity, and self-respect. In this article, I suggest ways in which the poverty of the mind can be rebuked while providing foundation phase learners with sound understanding of meaning in mathematics irrespective of prevailing conditions in their school environment.

2. Literature Review

Hawthorne[12] avers that human dignity means that an individual or group feels self-respect and self-worth. It is concerned with physical and psychological integrity and empowerment. Human dignity is harmed by unfair treatment

premised on personal traits or circumstances that do not relate to individual needs, capacities, or merits[12]. It also accounts for the kind and level of communication and creativity that integrates human society. Such integration relies on access to ideal reality through abstraction, intuition, and discursive reasoning; it relies on reason. The cycle of poverty in this article is conceptualized as a set of factors or events by which learners in poor, dysfunctional rural schools are disadvantaged such that they grow up and join higher grades with gaps in mathematics knowledge. This article challenges this hegemony and illustrates how out of school intervention can disrupt this trend for the creation of an environment that responds to the restoration of dignity to disadvantaged mathematics foundation classrooms.

Luby[19] warns that children growing up in poverty can experience detrimental effects which may lead to long-lasting negative consequences on brain development, emotional health, and academic achievement. Research has shown that growing up in poverty increases the likelihood that children will begin school well behind their more economically advantaged peers. In addition, children from low-income families often start school with inadequate social-emotional skills, which can stymie academic progress. In addition, O'Connor *et al*.[23] asserted that learning is enhanced when it also addresses the social and emotional development of children. In particular, children's development of self-regulatory skills that are vital to learning, include sustained attention span and curbing inappropriate behaviors. Kim *et al*.[13] also allude to the fact that the stress-burden of growing up poor may be an underlying mechanism that accounts for the relationship between poverty as a child and how well your brain works as an adult.

In addition, Kim *et al*.[13] asserted that children living with stress from childhood related to substandard housing, crowding, noise, and social stressors such as family turmoil, violence, or family separation conditions, usually have an effect on the relationship between childhood poverty and prefrontal brain function during emotional regulation. It, then, becomes difficult for learners from such situations to cope with school work that requires them to interpret and understand building blocks for mathematical concepts. In geometry, for example, children in the foundation phase must be able to identify and differentiate between shapes such as squares, rectangles, circles, and triangles. Other geometric concepts such as parallelism, congruency, similarity, and perpendicularity are then built from an understanding of and discernment of the characteristics of the basic shapes. Moreover, teaching is about putting learners where they will want to learn and where they can naturally discover their true passions. In the standard government oriented classrooms found in our schools, equipped with only chalkboard and chalk, learners' thinking is not stimulated. On the contrary, Dewey[5] notes that one cannot teach today the same way one did the previous days to prepare students for tomorrow. He pronounces that society with too few independent thinkers is vulnerable to control by disturbed and opportunistic leaders. A society that wants to create and maintain a free and democratic social system must, therefore, create responsible independence of thought among its young people.[5] Further asserts that giving the learners something to do, not something to learn, and the doing is such a nature as to demand thinking, learning naturally results. It is, therefore, unfortunate that some of the learners who were participants in this study were found deprived of an opportunity to learn in their 1st and 2nd years of their formal tuition due to the absence of qualified facilitators.

3. Theoretical Framework

An impoverished environment helps to ascertain the status of the poor. When a child is acquainted to having nothing, no space to play or no food, they tend not be free to adventure. The cycle of poverty condemned in this paper, attempts to break the cycle illustrated in Figure 1.

This is illustrated through a study conducted in a free after-school environment where learners were required to sort shapes and then justify how they grouped them. When sorting a variety of mixed shapes, learners must decide on how to group them being directed by their appearance. They then explain to each other why certain shapes belong together depending on the development of their visual skills. The study was conducted according to a specific framework making distinctions in mathematics education, which guided the systematic inquiry of how learners acquire mathematical knowledge and what instructional interventions contribute to the development of their learning. Theoretically, this article reports on a study underpinned by the variation theory. In this theory, Ling and Marton[18] noted that a person's ways of seeing or experiencing a particular object or material concept is considered fundamental for his or her learning. In turn, Marton and

Figure 1; The poverty cycle.

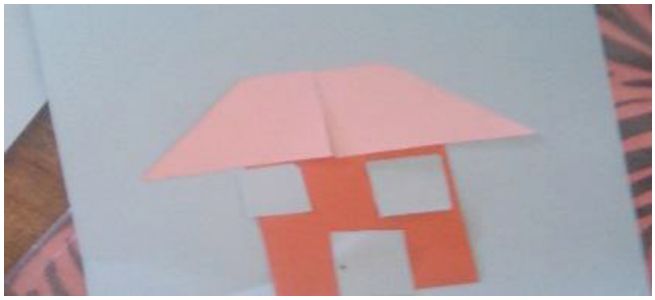

Figure 2; Learner 1's work.

Booth[20] asserted that how an object is seen or experienced, is determined by the aspects of the object the learner discerns and how he or she relates the discerned aspects to each other simultaneously.

According to Ling and Marton,[18] learning is always directed at something. It may be certain aspects of reality, an object of learning, a skill, or a phenomenon. The author asserts that after learning about something or skill, one then changes in the way he/she sees that object due to the things he/she has learned about it. The aspects of the object one notice and focuses on the form the basis of understanding that particular phenomenon. Variation theory sees learning as the ability to discern different features or aspects of what is being learned[18]. Researchers, Gu *et al*.[11] argued that repetitive learning with certain variations could be meaningful. The suggested repetition is misinterpreted in many mathematics classrooms such that learners are made to recite and repeat after the teacher the definitions of some concepts in the foundation phase. For example, learners would have to repeat after the teacher that, "a rectangle is a closed four-sided figure with two pairs of opposite sides equal and parallel." The number of times that the learners repeat this does not mean that they understand the object of learning. They also have to identify rectangular objects in their classroom environment and be able to discern some critical features that make that particular figure to be a rectangle.

Learners must then separate objects according to identified critical features from other objects that are visualized not to have such characteristics. This is an essential skill when they sort geometric figures even before they classify them. It is then after the separation that they learn to generalize that all shapes with particular critical features belong to a certain group. The teacher must design the lessons in a sequential manner that guides the learners to discern what is and what is not. Leung [17] asserts that discernment comes about when features of the concept have been focused and temporarily demarcated from all other features.

Much often when learners are given basic geometric shapes to sort in the foundation phase, they rarely group them according to the different shapes. They often group them according to the observed difference in color. This is in conjunction with the variation theory which describes three types of objects of learning[18,27] in any instructor–learner relationship. Those are (i) an intended object of learning which the mathematics teacher anticipates his/her learners to develop, (ii) an

enacted object of learning which results from the experiences that the interaction between learners and the teacher or between the learners and themselves affords, and (iii) a lived or actual object of learning experienced by learners in the interaction. Very often, the intended, enacted, and actual objects of learning do not coincide[14]. Perhaps this forms the contrasting result in many mathematics classroom environments where the teacher is convinced that he has taught a particular concept, yet the learners have a different understanding. Consequently, when the teacher extends and links other concepts to the previously intended object of learning, learners' mental construction is detached from making connections.

4. Methodology

This study reports specifically on the data collected during the first intervention intended to address the gap incurred in the foundation phase mathematics learning due to the absence of Grades 1 and 2 teachers in a primary school in the Eastern Cape province of South Africa. This intervention was directed at exposing learners to working with basic shapes in geometry known as space and shape at their level. The study was located within an interpretivist paradigm, which seeks to understand the situation from the perspective of the participants[1]. A qualitative research approach was followed in which structured worksheets covering mathematics content for Grade 1–5 were prepared for the learners to practice after school. Although the worksheets exposed the learners to various sections of mathematics done in the foundation phase, this paper only reports on shifts in learners' understanding of geometric shapes. A sample of 23 learners participated in this study.

This study became significant after an ethical clearance was granted by the UNISA ethics committee in 2017 on a project informed by engaging with meaningful teaching and learning of mathematical concepts: A case of Mt Ayliff District. During the visits to one of the schools in the district, it was observed that the Grades 1 and 2 learners had no teachers and were sharing the same classroom with Grade 3's. This indeed compromised their confidence in learning since they did not understand most mathematics content taught at that level. This is a characteristic common to many rural schools in the country. Most learners are left to wonder in those under-resourced classrooms without proper instruction. I argue in this article that the void incurred in mathematics knowledge stains them with the poverty of the mind. Edwards[7] avers that as a result of inadequate instruction, learners suffer not only in their present states but also in their futures. This author further noted that individuals who receive unsatisfactory schooling often face unemployment, welfare, and low standards of living when they are adults. The concern in this article is the fact that when learners lack basic and foundational mathematics knowledge, they develop phobia in following lessons and instructional levels such that the subject remains a monster in their education. The consequence is that they then cannot qualify to enroll for careers reliant on mathematics in their future. An environment of lack and poverty cycle then prevails.

Worksheets covering mathematics content for Grade 1–5 were prepared for the learners to practice after school. The facilitator was a retired community member whose duty in the project was to ensure that learning takes place in a conducive manner. Furthermore, the facilitator from time to time read out the questions loud to all learners in the intervention classroom. It is important to mention that the 23 learners who participated in this study attended and received tuition from different schools around the area. These learners' homes were housed in one location though.

The foundation phase in South African schools includes learners in Grades 1–3 while learners in Grades 4–6 belong to the intermediate phase. According to the Curriculum and Assessment Policy Statement, in the foundation phase learners are required to learn the following space and shape topics: Understanding and appreciation of the pattern, precision, achievement and beauty in natural and cultural forms focusing on the properties, and relationships; orientations, positions; and transformations of two dimensional shapes, and three-dimensional objects[26]. Children develop the understanding of space and shape in a sequential hierarchical manner described in the first three Van Hiele levels of spatial understanding[30]. Those are: Level 1 (Visualization and recognition) where children are able to see that shapes are different, for example, a square and a triangle, but cannot explain why they are different. In Level 2 (Analysis), children are able to name the properties that make up some shapes, and Level 3 (Abstraction) where children can classify shapes according to their properties, for example, a square is a type of rectangle. Data were collected through administration of worksheets to the learners, observations, and interviews with five learners based on their responses and illustrations on the worksheets. The

intervention was responding to the research question: How can we create an environment for the restoration of dignity to disadvantaged mathematics foundation classrooms?

5. Results

Certain themes emerged from data collected during analysis. In the first activity, learners were issued with different flat shapes in several colors and mixed shapes and were required to sort them. This activity was based on the principle that when children play with objects and draw them, they learn to understand geometry better. They were then given A4 size empty worksheets where they had to represent their sorted shapes. The following three illustrations were chosen, and the learners were later interviewed on how they sorted their shapes.

It can be noticed that instead of sorting or grouping the given shapes according to the similarity in shape and or color, Learner1 left out all the other shapes but chose a few significant ones. When asked how she did her sorting, he replied:

Bendifunaukwakhaindlu, umamaazohlalakuyoxasendisebenza. (I wanted to build a small house for my mom when I work). Ndenze I roof ngeziezifanayo, ndathatha le ebomvuenkuluyabaludongalwendlu, ndabekaifestilenomnyangongaphambili. (So I made a roof, and then took the red big shape to be the wall. I then placed a door and two windows in the front of my house.)

When I probed further to see if the learner knew the names of the shapes she used to build her hut, Learner 1 said:

"Lena ebomvu is a square" (The red one is a square).

Researcher: Why do you say so?

Learner 1: Wonkeamacalaayoayalingana (All its sides are equal).

I then picked up a rectangle, showed it to Learner 1 and asked: Is this a square?

Learner 1: No, la macalawayoawalingani, ndingathizizi square ezimbiniezihlangeneyo. (No, its sides are not equal, I can say it is two squares joined).

Researcher: Why is it not a square?

Learner 1: La macalaajongeneyoayalingana. The sides facing each other are equal.

Learner 1's response indicates that he could discern what is a square from what was not. He could only site one critical feature for a square but could not understand the fact that the square was also some form of a rectangle. The learner operated in the second level of Van Hiele since she could analyze by naming some properties of the shapes given to her.

Learner 2 chose only triangles and arranged them in her A4 size paper such that the enclosed figure was a square. This learner did not indicate that he did not understand the instruction, but used and arranged his shapes to form what was appealing to his eyes. During interviews I asked him:

Researcher: How did you end up with this structure? (pointing at his presentation).

Learner 2: Ndiyendabonauba la matrayengileayalingana, ndabekaafanayoubaajongane. (I could see that the triangles were equal, so I decided to arrange them such that those with the same color faced each other.) Probed further:

Researcher: So then what shapes have you formed in your presentation?

Learner 2: Square here and triangles around.

Researcher: How different are they?

Learner 2: Three amacala e triangle and four awe square.

6. Discussions

In conjunction with the first three Van Hiele levels of geometric thought, the growth of space and shape knowledge construction in this study was monitored. Nonetheless, the analysis in this paper follows themes identified as data was coded with guidance from the variation theory. During the time of observation, the after-school classes had been going on for >6 months. Learners were very much passionate about those classes to an extent that even if they were absent at school; they would not miss their intervention classes. Usually, the intervention classes were conducted once a week every Wednesday afternoon from 4 pm to 5 pm. This is where they met, played, and shared numerical competence skills with their peers. Nonetheless, the administration of worksheets took place during the 10 days spring school vacation period

in which the intervention class was conducted for an hour daily. Learners were committed to these classes. It is where they experienced restoration of their dignity with respect to gap closure in their mathematics skills. It was alarming to know that this was the only time some of the learners from local schools were exposed to mathematics learning. Each of the learners worked independently at first and then shared information as groups when they get the idea on how a mathematical problem could be tackled. This was a free environment that allowed learners to exercise their creativity without guidance or fear of doing things incorrectly. The importance was to restore their dignity and set their minds free while they own and experience learning.

Learner 1's response indicated not only the mathematics applications displayed by the learner but also the cry and the anticipation the learner had to restore her dignity. The learner was not responding to the instruction given, perhaps did not even understand it, nonetheless used the platform to air out her frustrations with respect to the projections of what she wants in future, to disrupt the cycle of poverty signified by unbecoming conditions of structure in her life. This is in conjunction with Edwards[6] who asserts that the mind has the potential to change over time and enables one to understand how disadvantaged children can learn to think outside of their circumstances. This then filters to the brain that can deal with situations that are detrimental so as to take on conditions that are beneficial to grow the child's confidence for a defined future.

Learner 2's distinction indicates that the learners could separate the shapes and also name them. Furthermore, the construction of a closed figure could indicate the boundedness the learner wanted to experience in his life. The freedom given to the learners to sort the shapes in their own ways and describe how they see things without intimidation of being right or wrong indicates that their views are important. Their dignity is restored and confidence of tackling more problems in mathematics is greatly valued. This becomes the foundation for their brighter future and hope for breaking the trend of poverty surrounding them. Of much significance was the chance availed to them through the intervention classes to learn concepts in space and shapes. This helped them to be able to identify with their immediate environment as they connected what is learnt in the intervention class with what they already knew. The peer support they got from the learners who were taught in other local schools in the group, together with those in higher school grades, added to their knowledge constructions.

Further conversations with the learners revealed how they had big dreams to be engineers when they are old. There was also fear of the fulfillment of such wishes since they had no teachers to teach them in the first and second grades. As it was observed in Figures 1,2,3 and 4, a number of learners used this exercise to represents beautiful huts that they wanted to build such that their home situations could improve. This concurs with D'Ámbrosio[4] who asserts that when children describe the geometry of a building or how they construct an object, it is the first phase of a heritage restoration work. This implies that children try and connect with their culture and environment in picture representation.

Learner 4 presented the illustration represented in Figure 5 instead of sorting the given shapes. During interviews, he described his illustration as a person's face, with forehead, two eyes, a nose, and a mouth. He justified that he thought he must illustrate something different from other learners as he noticed that many children were representing huts.

Learner 5's illustration is represented in Figure 6. There were two other illustrations from the whole group who sorted the given shapes according to similar shapes. This learner explained during interviews that he required another worksheet

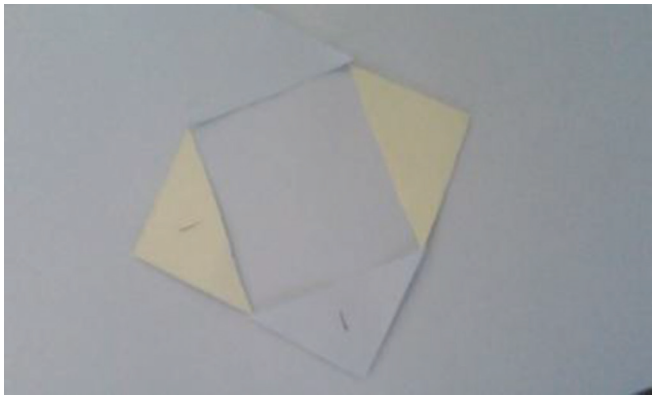

Figure 3; Learner 2's work.

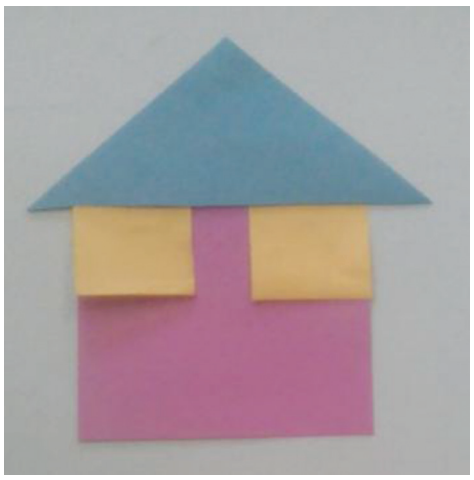

Figure 4; Learner 3's work.

Figure 5; Learner 4's work.

Figure 6; Learner 5's work.

to be able to place the different triangles and squares he picked up from the shapes given to him. The learner was then asked to explain to the other learners how to sort the shapes. What it meant to sort shapes, but the learner went on to ask the other learners to identify similar shapes in their classroom. He took over the instruction in the class such that they ended up playing with shapes and describing their properties.

7. Conclusion

The creation of a supportive and caring environment can develop the learners' resilience, restore their dignity and increase their competence in understanding of basic mathematics concepts. The learners also develop good relationships with each other while they share information and help others to restore their dignity and lead them ultimately to independence of acquiring other mathematical skills and ownership of the learning experiences. The intervention with the after school program may serve to break the cycle of poverty for the disadvantaged learners and restore their competence in understanding mathematics concepts. This breaks the cycle where learners are subjected to shame since they do not receive proper tuition in their schools due to absence of qualified teachers. The intervention classes expose learners to self-learning skills where they interact with the material and are assisted by other learners who understand certain mathematics skills. The gap in their knowledge is closed while they learn to share what they know with fellow learners. Although poverty cannot be eradicated in one method, rather it takes intervention strategies of this nature to restore confidence to learners, and providing platforms where informed and non-informed learners can work together to bring change in each other's lives. Moreover, the intervention classes introduced the children with the tools to be confident in their abilities to be academically successful, thereby breaking the cycle of poverty for them and their families. The disadvantaged learners without trained teacher's experiences may have gaps, but through intervention classes their knowledge can be built while expanding their repertoire of skills and competencies.

References

1. Ary D, Jacobs LC, Razavieh A. Introduction to Research in Education. Belmont, CA: Wadsworth/Thomson Learning; 2002.
2. Brownell WA. Psychological considerations in the learning and teaching of arithmetic. In: The Teaching of Arithmetic: Tenth Yearbook of the National Council of Teachers of Mathematics. New York: Columbia University Press; 1935.
3. Bruner JS. The Process of Education. Cambridge, MA: Harvard University Press; 1960.
4. D'Ambrosio U. What is ethnomathematics, and how can it help children in schools? Teaching Children Mathematics 2001; 7(6): 308.
5. Dewey J. How We Think: A Restatement of the Relation of Reflective Thinking to the Educative Process. Boston, MA: D. C. Heath and Company; 1933.
6. Dienes ZP. Mathematics in the Primary School. London: Macmillan; 1966.
7. Edwards S. The Effects of Poverty on Achievement Gap: A Quantitative Analysis Using Stratification Theory. Ogden: Proceedings of the National Conference on Undergraduate Research (NCUR) Weber State University; 2012. p. 29-31.
8. Gardiner M. Education in Rural Areas. Issues in Education Policy Number 4. Braamfontein, South Africa: Centre for Education Policy Development (CEPD); 2017.
10. Jeanty J. The Effects of Poverty: Classroom. West Lafayette: Purdue University, Leaf Group Ltd.; 2008.
11. Gu L, Huang R, Marton F. Teaching with variation: A Chinese way of promoting effective mathematics learning. In: Fan L, Wong NY, Cai J, *et al*. editors. How Chinese Learn Mathematics: Perspectives from Insiders. Singapore: World Scientific Publishing; 2004.
12. Hawthorne L. Constitution and Contract: Human Dignity, the Theory of Capabilities and Existenzgrundlage in South Africa. Jurisprudentia: Studia Universitatis Babes-Bolyai; 2011. p. 27.
13. Kim P, Evans GW, Angstadt M, *et al*. Effects of childhood poverty and chronic stress on emotion regulatory brain function in adulthood. Proceedings of the National Academy of Sciences 2013; 110: 18442-18447.
14. Koichu B, Zaslavsky O, Dolev L. Effects of variations in task design using different representations of mathematical objects on learning: A case of a sorting task. In: Margolinas C, Ainley J, Frant JB, *et al*. editors. Proceedings of ICMI Study 22 Task Design in Mathematics Education. Oxford: Oxford University Press; 2013. p. 463-472.
15. Lebech M. What is Human Dignity? Ireland: Faculty of Philosophy, National University of Ireland, Maynooth; 2009.
17. Leung A. Dynamic geometry and the theory of variation. In: Pateman N, Dougherty B, Zilliox J, editors. Proceedings of the 2003 Joint Meeting of PME and PMENA. Honolulu: University of Hawaii; 2003. p. 197-204.
18. Ling LM, Marton F. Towards a science of the art of teaching: Using variation theory as a guiding principle of pedagogical design. International Journal for Lesson and Learning Studies 2012; 1(1): 7-22.
19. Luby JL. JAMA Pediatrics. Science News, July Edition. St. Louis: Washington University School of Medicine; 2015.
20. Marton F, Booth S. Learning and Awareness. Mahwah, New Jersey: Erlbaum; 1997.
21. Mullis IV, Martin MO, Foy P, *et al*. TIMSS 2015 International Results in Mathematics, Retrieved from Boston College, TIMSS and PIRLS International Study Center; 2016. Available from: http://www.timssandpirls.bc.edu/timss2015/international-results/.
23. O'Connor EE, Cappella E, McCormick MP, *et al*. Enhancing the academic development of shy children: A test of the

efficacy of insights. School Psychology Review 2014; 43(3): 239-259.
24. Phan KL. Growing up poor, stressed impacts brain function as adult. Science News: University of Illinois at Chicago College of Medicine and Senior Author of the Study; 2013.
26. Reay D. We never get a fair chance: Working class experiences of education in the twenty-first century. In: Atkinson W, Roberts S, Savage M, editors. Class Inequality in Austerity Britain. Basingstoke: Palgrave; 2012.
27. Runesson U. Beyond discourse and interaction. Variation: A critical aspect for teaching and learning mathematics. The Cambridge Journal of Education 2005; 35(1): 69-87.
28. Spaull N. South Africa's Education Crisis: The Quality of Education in South Africa 1994-2011: Report Commissioned by CDE October 2013; 2013.
29. Timaeus I, Simelane S, Letsoalo T. Poverty, Race, and Children's Progress at school in South Africa. Policy Brief. Cape Town: School of Development Studies, University of KwaZulu-Natal; 2011.
30. Usiskin Z. Van Hiele Levels of Achievement in Secondary School Geometry. Chicago, IL: CDASSG Project, Chicago University; 1982.