Geometry Prior Knowledge in Grade 9 Mathematics to Reflect in the Matjhabeng Local Municipality

Prior knowledge refers to the information possessed prior to the acquisition of new ideas. Learners with insufficient prior knowledge find it difficult to participate in the teaching and learning process because they are unable to make a connection between their previous experiences and the new information provided by the teacher. The purpose of this study was to contribute on the perfection in the teaching and learning of geometry in Grade 9 at the Matjhabeng Local Municipality; by determining if the prior knowledge within learners commensurate with what will be learnt in Grade 9. The research was necessitated by the fact that numerous reports state that learners in South African schools in general are not performing well in mathematics. The researcher employed a mixed method research design, namely quantitative and qualitative research design. The sample of the study involved 24 Grade 9 learners and 6 Grade 9 mathematics teachers from 6 different secondary schools in the Matjhabeng Local Municipality. The data was collected through a geometric assessment, questionnaire and semi-structured interviews for the teachers, in which data analysis was based on the themes that emerged from the teachers' responses. The geometric assessment revealed that Grade 9 learners in Matjhabeng still have challenges in the learning of geometry and find it difficult to match the statement and its corresponding reason or theorem. From the data collected through interviews, teachers also indicated that Grade 9 learners are struggling to understand congruency, corresponding angles, alternate angles, co-interior angles, and parallel lines. The questionnaire responses from the learners signify that learner have a negative attitude towards geometry and as a result, their performance is not good at all. The study therefore recommends that the Department of Basic Education must involve Grade 9 mathematics teachers in curriculum design. In schools, teachers must be placed in grades according to their qualifications and experience and be continuously developed in the field of mathematics.

Keywords: Prior knowledge, geometry, teaching, learning, teacher, learner.

Introduction

Prior knowledge is a foundation, or a fundamental component of what learners must know before they can engage in a new topic or concept, according to this research (Klosterman, 2015). Learners poor performance in geometry could be linked to various factors relating to a poor foundation of basic knowledge from their primary stage, lack of willingness and readiness to learn geometry(Mamiala; Mji & Simelane-Mnisi, 2021) This is also a clear indication that learners lack prior knowledge domain to support learning in a new domain of mathematics, geometry. People acquire new knowledge in the context of their existing knowledge. When learning new geometry concepts, for example, learners build on prior understanding of related geometry concepts and techniques (Sidney & Alibali, 2018). Prior knowledge, according to Mabonga (2021) is the information

one knows before learning new ideas or concepts. This information could have come from their personal, social, and cultural influences over time. It includes pre-existing knowledge, ideas, and attitudes that influence how they pay attention to, evaluate, and arrange incoming data.

Teachers should play a larger role in assisting students in improving their prior knowledge by providing suitable, sufficient, and high-quality information that will be useful even in higher grades (Diaz, 2017). According to Sidney and Alibali (2018), the learner's own existing knowledge can be used to support the new conceptual learning. Gocsal,2016 further declares that concept maps can also be used to strengthen prior knowledge. Prior knowledge serves as a foundation or base for learning new concepts. During the teaching and learning process, learners easily conceptualize content and make sense of new concepts and experiences based on existing understanding of the topic under discussion, which enhances their learning foundation (Alex, 2018) Prior experiences of learners are vital in establishing a concrete learning foundation, according to Wenk (2017). Learners with enough prior knowledge, such as those who grew up in a language and literacy-rich environment, are more likely to build on their knowledge constructively and have fewer learning difficulties. In a constructivist classroom, activities lead to concepts, learners create meanings, learning occurs, and abstract concepts become meaningful, transferrable, and maintained because of their association with the completion of a concrete task. This means that, to stimulate learner's prior knowledge.

The Purpose and Research Question

Considering the role of prior knowledge in learners to fully understand geometric concepts and their application, the following question was formulated

- What geometry prior knowledge do grade 9 mathematics learners reflect?

This above question will be answered by the teaching techniques and strategies that the grade 9 mathematics teachers will apply to alleviate the misconceptions that the learners have in geometry.

Literature Review

The literature cited in this study emphasizes the need of exposing a learner to knowledge that will aid him or her in future learning because past knowledge plays such an important role in the teaching and learning process. Prior knowledge is an essential component of learning; it serves as the foundation from which a person can launch into a new topic, and it also serves as the mash that connects additional material to create new and higher-quality knowledge (Diaz, 2017) To improve learners' prior knowledge, teachers must actively include learners in the teaching and learning process to assist them in enriching existing experiences,

which serve as the foundation for developing new knowledge, skills, values, and attitudes (Akaraka, 2015) A concept map can be used to depict the relationship between mathematical concepts. A concept map is a graphical tool that displays the relationships between concepts in a systematic way (Malatjie & Machaba, 2019). Malatjie and Machaba (2019) go on to say that when learners are taught utilizing idea mapping as a teaching approach, their conceptual knowledge of coordinate and transformation geometry improves. The Pirie-Kieren Theory identifies seven stages that are linked to the constructs of conceptual understanding: primitive thinking, image making, image having, property noting, formalizing, observing, structure, and investigating (Malatjie & Machaba, 2019). "Primitive understanding, which in constructivism's perspective may be referred to as previous knowledge, refers to the knowledge that an individual brings to a setting," says the theory. At this phase, the process of understanding growth begins. This is the type of prior knowledge that gives new knowledge meaning. "A learner can establish distinctions in his or her past learning and apply that knowledge in new ways that involve actions and activities with that knowledge," according to image creating. This implies that picture knowledge, when combined with basic information, is a knowledge that can be put into practice.

At the visual layer, the learner is no longer bound to an activity; instead, he or she can create a conceptual strategy for the activities and implement it effectively. Property noticing is a level of understanding attained when a person can manipulate or combine visual items to create context-specific, relevant attributes. Without needing to refer to a specific action or image, the learner can think deliberately about the generalised properties and work with the notion as a formal object at the formalising layer. These seven levels could be linked to constructivism's understanding theory to help people build their understanding as a constant process of organizing and restructuring knowledge systems. These levels also show how a learner can develop a mental understanding of any mathematical concept. (Malatjie & Machaba, 2019)

According to Siu-Yung Jong and King, learners can be assisted in activating past information and relating new geometric concepts to their prior understanding. By 2020, there's a chance they'll be able to remember and apply what they've learned in geometry (new learning is constructed on prior knowledge) The more we study, the better, according to Dong, Siu-Yung Jong and King (2020). The more we help learners (activate their existing knowledge), the more likely they are to learn correctly and less likely to misunderstand new concepts (Wenk et al, 2017). A connection to prior knowledge should always be made at the start of a mathematical course. When each learner enters the classroom for the day, the teacher's connection to their prior knowledge has a big impact on what the learners have learned in the specific settings offered by geometric activities that the learners are invited to explore (Sidney & Alibali, 2018) Instructors are concerned about the high percentage of failure in external assessments among Nigerian secondary school learners, prompting them to demand better teaching and learning tactics in the classroom. Teachers believe that exposing learners to instructional objectives before they are taught will result in more effective learning, and the current focus is on how prior knowledge of instructional objectives can aid

learning and help learners organize their learning activities and study more effectively to meet the set objectives (Akaraka, 2015).

The impacts of prior geometry knowledge on instructional objectives in grade 9 in the Matjhabeng local municipality are investigated in this study. High mathematics dropout rates in Grade 9 have sparked debate regarding the causes and effective treatments for learners (Department of Basic Education, 2019) The best predictor of academic accomplishment is a learner's past knowledge, which is widely stressed (Binder; Sandmann; Sures; Friege; Theyssen & Schmiemann, 2019). When learners are appropriately instructed, inquiry learning is a great learning strategy. The learners' prior knowledge, the domain, and their interactions all play a role in its success (Van Riesen, Gijlers, Anjewierden, & De Jong, 2019). Prior knowledge has long been seen to be the most significant factor in learning and success. The amount and quality of prior information influences both knowledge acquisition and the ability to use higher-order cognitive problem-solving skills, according to Dong: Siu-Yung Jong & King (2020). Prior knowledge refers to what students already know about a topic. When students read a text, they must be able to connect the information to what they already know about the subject (Hall, Burns & Edwards, 2011). According to Hall et al, (2011), middle school learners with more prior knowledge about a topic were better able to locate relevant websites faster than students with limited prior knowledge, and learners with little prior knowledge and only limited online reading skills had the most difficulty understanding online texts. Learners' prior knowledge and cultural underpinnings are linked when they connect their prior knowledge and cultural underpinnings, according to Robinson-Zanartu, Doerr, and Portman (2015). This act of pre-assessing and analysing existing knowledge provides the hook on which new associated knowledge can be hung before beginning a unit of study (Van Riesen; Gijlers; Anjewierden & De Jong, 2019) Learners' prior knowledge is important because it allows the teacher to correct misconceptions. Learners may come into the classroom with erroneous perceptions or beliefs about what the instructor is expected to teach. Erroneous information, according to Diaz (2017), can lead to misconceptions, which can alter learners' perceptions of current facts. This means that before teaching new material, teachers should identify and correct learners' misconceptions. Learners that have accurate prior knowledge are more confident during the teaching and learning process. According to Van Riesen, Gijlers, Anjewierden, and De Jong (2019), learners with sufficient prior knowledge can freely participate in the teaching and learning process because they can establish a relationship between their previous experiences and the new content provided by the teacher. Confidence enables the learner to deal with obstacles, challenges, and concerns while maintaining a positive outlook. A happy and productive learner can deal with any situation that arises in his life.

Methodology

Sample and Sampling Procedures

The target population of this study consists of all Grade 9 mathematics teachers in the Free State province. The purposeful sampling technique was used to select grade 9 mathematics teachers in the Matjhabeng local municipality in the Lejweleputswa education district.

Research Instrument

The data for this study was assembled from the responses that were given by the teachers during interview sessions and the core issue was to find out if learners do utilise prior knowledge in answering geometry questions. Teacher's answers were recorded literally in the way they responded, using voice record of the researcher's cell phone.

Validity and Reliability

The pilot study on grade 9 mathematics teachers who were not part of the final research, was first carried out in 2 schools in different locations. The information gathered were analysed in themes. This study was carried out using small sample of teachers, the findings of this research cannot be generalised to 3~other grade 9 mathematics teachers in other education districts in the Free State province.

Procedure

Permission to conduct research at schools was granted by the Department of Basic Education in the Free State. The researcher sent out letters to the grade 9 mathematics teachers who were purposefully selected, requesting them to take part in the research project.

Data Analysis Methods

The data collected from teacher's interviews was analysed based on 2 themes, and those were, (i) misconceptions with parallel line and angles and misconception with similarity. (ii) misconceptions with congruency.

Results

During the analysis of the data gathered from the interviews, 6 teachers were named, Teacher A, Teacher B, Teacher C, Teacher D, Teacher E and Teacher F. In theme 1, Teacher A indicated that grade 9 learners because of the lack of prior knowledge in geometry, do not identify that if parallel line are not shown with

arrows pointing in the same direction. then those lines are not parallel. Teacher E emphasised learners presume by looking at the diagram that alternate angles are equal, even though the 2 parallel lines do not have arrows. Teacher F reiterated by saying that due to insufficient knowledge of geometry in the previous level, learners do not understand that the 2 figures that have the same shape but have different sizes and one has the same shape as the mirror image of the other. Teacher F further indicated that poor results in geometry are brought by the fact that similarity and congruency are not taught as two separate concepts but are taught at the same time and that brings confusion to the learners. In theme 2, Teacher B highlighted that learner find it difficult to understand that congruency means the same shape and size. Teacher C and Teacher D had that same understanding that learners also find it challenging to understand the conditions of congruency and the condition on similarity.

Discussion

The emphasis on this study was to explore the misconceptions that the learners have when answering geometry questions which are brought about by the lack of prior knowledge gained in the former grades. Klosterman (2015) declares that learners should be able to recognise the many new connections and their prior knowledge in mathematics to increase their understanding. The findings of this study in qualitative analysis, confirm that mathematics teachers do not see the connection between prior knowledge that learners have accumulated, and the new geometry concepts introduced to them by the teachers. Learners at grade 9 still cannot identify if lines are parallel, if angles are co-interior, if angles alternate and how figures look like if they are congruent and similar. Mamiala; Mji and Simelane-Mnisi (2021) emphasise that learner's bad performance could be linked to a poor foundation of basic knowledge from the learner's primary stage, and prior knowledge of geometric ideas is critical for the learner to build self-efficacy in understanding geometry.

Conclusion and Recommendation

For the learners to have more understanding of geometric concepts as they are taught geometry through different grades during their scholastic career, prior knowledge of geometry ideas must be taken into cognisance. Motivation, strong self-efficacy, and prior knowledge gathered by the learner, according to Mamiala; Mji and Simelane-Mnisi (2021), have the power to enhance confidence in the learner in terms of grasping geometrical topics faster.

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