







associated with teachers' methods of teaching have resulted in poor teaching standards in mathematics [17,18]. The poor standards have also been exacerbated by a large number of underqualified and unqualified teachers who are faced with teaching in an overcrowded environment not conducive to teaching and learning. Further studies conducted by the educational researchers [17;19] have identified various reasons for the cause of incompetency among teachers as well as poor performance in mathematics. Amongst these are outdated teaching practices, teachers' lack of basic content knowledge, underqualified or unqualified teachers, overcrowded and poorly equipped classrooms, inefficient teaching approaches and unprofessional attitudes [18,20]. Further to this are teachers' inability to help learners develop their own thinking, enhance metacognitive strategies and become problem solvers [6,21]. Related studies such as Mevarech and Kramarski [22] investigating challenges faced by teachers in South Africa and many other countries with developing economies, refers to the lack of teachers' mathematical content knowledge. Outdated teaching practices and lack of basic content knowledge have resulted in poor teaching standards as well as learners' poor performance in mathematics. This pattern has alarmed many scholars such as Markey, Power and Booker [23], Moloi [24], Nabie and Sofo [25], Nkopodi and Mosimege [9] who have conducted research on the use of indigenous games in developing mathematical concepts which ensures learners' freedom of learning. Their findings are supported by Nabie and Sofo [25] who indicated that personal mathematical construction of learners' own learning and mathematics learning is supported by the use of games in mathematics education.

According to Grane [26], the problem of poor performance of learners is not confined to languages only, as experienced in South African schools, but is also prevalent in other subjects as well. According to Gardner [27], "the flattery or detailed compliment of this assertion is essentially demonstrated by the number of learners who are poor mathematicians, and not only poor mathematicians, but poor in other related school subject skills". Different socio-economic factors, lack of basic mathematics skills and lack of resources influence the performance of learners in mathematics [28].

A research document developed by the National Research Council [29] addresses the learning process. The purpose of this report was to discuss teaching methods which could be used to improve the learning of mathematics so that learners are proficient. Teaching of number sentences and geometric patterns can be taught both with a formal or informal approach. The most commonly used method is chalk-and-talk method which tends to be a monologue presentation done with the teacher illustrating the content by drawing with chalk, hard

crayon, or pastel, or with dry-erase markers on a blackboard, traditionally, or a whiteboard. The chalk-and-talk method of teaching focuses on the blackboard and the voice and the physical activity of the teacher. This method is preferred for presenting lectures and talks. The lecture method is based on the philosophy of idealism and refers to the explanation of the topic to the students. According to Renzulli [30] the teacher clarifies the content matter to the students by using gestures, simple devices, by a change in voice, change in position and facial expressions. In this teaching method, teachers are more active and learners are passive but the teacher also asks questions to keep the learners attentive.

The flipped classroom, defined by Zainuddin and Halili [31] as an instructional strategy and a type of blended learning, reverses the traditional learning environment by delivering instructional content, often online, outside of the classroom. The flipped classroom has been incorporated as a teaching approach as it moves activities, including those that may have traditionally been considered as something done at home, into the classroom and focuses on learner engagement, the use of technology and the opportunity to create meaningful learning opportunities where topics are explored in greater depth. The flipped classroom allows learners to watch online lectures, collaborate in online discussions, or carry out research at home while engaging in concepts in the classroom with the guidance of a mentor.

Mphuthi [32] suggests that geometry can be taught in an informal way with cutting and folding incorporating practical methods to make learning more meaningful. This method is interconnected with the discovery method which is defined as a process that involves problem solving situations where the learners draws on their own experiences and prior knowledge and where learners interact with their environment by exploring and manipulating objects, wrestling with questions and controversies. Aligned with the flipped classroom is the game-based learning approach, defined as an approach that involves innovative and creative apps that are based on computer games that possess educational benefits. This type of learning according to Chien, Wu and Hsu [33] support learning and teaching enhancement, assessment and evaluation of learners.

## **5.2. The use of Indigenous Games such as Morabaraba and Others, in the Teaching of Number Sentences and Geometric Patterns**

Smith [34] argues that "good teaching is understood to involve a process of facilitating learning rather than being the simple transmission of knowledge from the educator to the learner". The teachers' role is to facilitate learning using a variety

of approaches and methods to ensure that the diverse needs of learners are addressed and that all learning styles are taken into account. This means that flexible teaching approaches should be used by teachers in order to address the different learning styles of the learners, as supported by the NCTM [28] and the lesson needs to be presented according to the learners' preferred learning style.

Copur-Gencturk [35] suggests that understanding the definition of the concept being taught plays an essential role in teaching and learning. For example, if the educator is teaching the concept of the various functions, there should be a clear definition of the concept and the types of functions. These should be well explained to the learners during the introductory stage of the lesson. Teachers should encourage a "hands-on" and interactive approach to learning with activities offering learners the opportunity to apply and interact equally with the thinking and performing aspects of learning. Learners should be given the opportunity to collaborate, reason, discuss and negotiate during problem-solving.

Teachers should regard learners as co-producers of new knowledge and skills but need to take into account prior knowledge of learner for learning to be effective [36]. This would assist the teachers in scaffolding the learners and assist them in achieving the learning outcomes. However, the learners should not be viewed as passive recipients of information and empty vessels to be filled with good information by the teachers. The shift from an "instructivist" to a 'constructivist' approach should be adopted by the teachers of mathematics and other subjects. The quality of instruction, which includes using strategies like effective questioning and continuous assessment, would thus be enhanced.

In order for learners to learn effectively and achieve learning outcomes, teachers often need to change or adapt the teaching/learning methods particularly when learners do not understand the work clearly during lesson delivery. The learning environment should create a connection between real-life situations and mathematical concepts taking into account the visual, the theoretical as well as the logical. Authentic learning is prominent in teaching geometry, as reflected in current school curricula [37]. The teaching of number sentences and geometric patterns could also use indigenous games like *morabaraba*. Moloi [24] used *morabaraba*, a board game, to teach mathematics for better understanding. As previously explained, *morabaraba* is the board game played by two people, with 24 tokens with 12 for each player. The aim of the game is to create rows of three cows (tokens), being vertical, diagonal or horizontal. The following mathematical concepts: area, ratio, proportions, geometric figures, numerical patterns and similarity are addressed in the playing of this game. Mathematical skills targeted include logic,

reasoning, construction, accuracy on calculations, interpretation and identifications [38].

Many indigenous games can be used in the mathematics classroom. For example, a game called *arauru* or *pada*, where a child balances on one foot and uses it to push a stone from one drawn rectangular box to the other, can be used in the teaching of the concepts of balancing and counting. When playing the game, the player scores more by balancing on one foot without resorting to using the other foot and pushing the stone across squares drawn on the ground. In order to balance on one foot, one has to strategically position oneself on that foot. Learners also learn to count in the process because one has to remember whether she/he will start from which box. A see-saw using a plank can also be used to teach balance, mass and weight [38].

According to Mbusi [39], the use of isiXhosa dance can be used to explain geometry concepts such as right angles. A study conducted by Hunter et al. [40] revealed the teaching of mathematics using kinaesthetics or musical ways. In a similar manner, Muller et al. [41] used the gumboot dance linking it to mathematical concepts. Which makes it evident is that culture, language and geographical spaces have a continuous impact of mathematical development Almond and Verba [42] as well as Owens [43] stated that games are activities with integrated opportunities, a statement supported by Nabie et al. [44]. Therefore, this means mathematics teachers, especially those in rural schools, need to be trained and exposed to the concept of ethno-mathematics by incorporating indigenous knowledge systems in the teaching of complex mathematics topics.

## 6. Methodology

The research, which was conducted in the Motheo district of the Free State province of South Africa, is a qualitative study that used a phenomenological approach and the interpretation of raw data obtained from the participants [45]. In this study, two Intermediate Phase teachers were purposively selected from two schools and the schools were purposively selected based on a cluster sampling technique. The selected teachers had a minimum of five years' teaching experience, during which time, they should have acquired sound subject matter knowledge in the teaching of mathematics. Two instruments were used for data collection, namely observation and interviews. During the observation, both teachers were observed as they presented their lessons. Unstructured and open-ended interviews were also conducted with the two teachers thereafter, which were recorded and later transcribed and analysed.

## 7. Data Analysis

Qualitative analysis involves three elements which are arranging data, breaking it into manageable units, synthesising and searching for patterns. This is process used by the researcher to develop theories from the information gathered through interviews, observation, and documents analysis. The gathering of information involves the selection of data, techniques of data collection and the transcription through note taken [58]. In this study, content analysis was used for data analysis. Content analysis is defined as a process that involves observation, verbatim transcriptions, and responses from the open-ended questions as well as video recordings obtained from the participants of any study for credible data [47]. Therefore, in this study the data analysed included notes taken during observation of the lessons presented by the participants as well as open-ended interviews conducted with participants to generate better outcome considering the purpose of the study. Firstly, the researchers transcribed the interview data verbatim, read and reread through the data over

and over again until they were familiar with the content. They then used the explicit rules of coding to code chunks of text which were then arranged in content categories and later into themes and sub-themes.

The researchers examined the data in-depth which provided detailed descriptions in an attempt to answer the research questions. The analysis of the participants' responses to each question is presented in the subsection below and begins by offering an outline of the biographical information of participants.

### 7.1. Biographical Information of the Participants

A total of two teachers were invited to participate in the study. For an in-depth analysis, it is important to present a brief overview of the biographic characteristics of the participants, which include their age, sex of respondents, years of teaching experience, highest qualification, position held and type of school. This is presented in Table 1 below.

Table 1. Biographical information

Participants	Age	Sex	Teaching Exp.	Highest Qualification	Position held	Type of school
Teacher (TA)	54	F	9 years	B.Ed.	Teacher	Public
Teacher (TB)	49	M	25 years	B.Ed.	HOD	Public

It is evident from Table 1 that the two teachers who participated in the study were qualified teachers with a Bachelor degree in Education. One participant is a Head of Department (HOD) (post level two educator) and the other is post level 1. Both work in the selected public schools in a rural area.

### 7.2. Data Presentation

**7.1.1. Classroom observation.** The researcher observed the teachers in the teaching of mathematics lessons and the observations are presented below: Both teachers used the chalkboard to capture information but they applied it differently. For instance, Teacher A would more often write only correct answers on the board. Teacher B would explain both the correct and incorrect answers given by learners on the board, and then encourage learners to correct their mistakes. In most cases, he encouraged learners in constructive discussion about their views based on the problem at hand before pronouncing the correct answer.

Teacher A used a traditional approach of teaching whereby he would often give learners explanations rather than supporting learners to make sense of the information or problem given. On the other hand,

Teacher B gave learners homework once a week after he realised that most learners were struggling to apply their knowledge and therefore made use of indigenous games to express some concepts to the learners for better understanding. The extract from the teachers' interviews substantiated the above statement.

**Teacher A:** *I usually provide answers for learners where they face problems by making use of indigenous games by guiding them to apply its use.*

**Teacher B:** *As for me, I allow or force learners to deliberate on their answers and further ask them to draw conclusion for themselves under my supervision and later show the correct answers through discussions.*

The researcher observed some teacher-learner interaction during the teaching and learning process. It seems that both teachers interacted with learners for purpose of maintaining learners' interest and developing understanding of a particular concepts or topic. The practice helped the teachers identify learners that were struggling when doing corrections.

**7.1.2. Interviews with participant teachers.** In this section, responses given by teachers during the

interviews are presented with some discussion as demonstrated below.

**Question 1(a): Name at least 3 major barriers or challenges that you have encountered in mathematics classes.**

Based on this particular question, all the participants, drawing on their experience, responded by stating factors that they classify as barriers to the learning and teaching of number sentence and geometric patterns. The participants listed the inability of learners to use local objects for learning mathematics as a barrier to the learning and teaching of number sentences and geometric patterns, as based on their experiences. These two participants highlighted the following as the challenges faced by learners in their classrooms.

**Teacher A:** *Learners struggle to understand some of the mathematical concepts introduced by their teachers, especially when the teacher has a maths phobia but is teaching the subject due to redeployment. For example, learners struggle to understand concepts such as ascending and descending order, especially where their teachers failed to use practical examples to explain the concept.*

**Teacher B:** *Number sentences and geometric patterns are difficult for learners. Learners had difficulty in understanding these mathematical concepts.*

**Question 1(b): To what extent have you assisted or in what ways do you assist learners with the barriers or challenges mentioned above?**

Teachers stated that they usually utilised different activities and non-traditional methods to help learners overcome their challenges. In addition, they provided extra classes to assist learners. The excerpt below from the teachers supports the above statement:

**Teacher A:** *I usually write the definitions for learners on the board; thereafter I explain the terms used. I usually use teaching aids in the classroom, particularly when presenting shapes and spaces.*

**Teacher B:** *I always conduct extra classes for learners that are struggling to solving mathematical word problems especially in number sense and geometry patterns. During those extra classes, I use indigenous materials that are user friendly during my teaching to help learners understand the mathematical concepts being taught. This gives the learners the opportunity to showcase their talents in learning process.*

**Question 2 (a): What were the measures that you employed when you noticed that learners were struggling with geometric patterns and number sentences?**

The two respondents claimed that though they used chalk-and-talk methods, they also made use of examples, as well as indigenous games to assist the learners in Grade 4 to understand number sentences and geometric patterns. For example, the teachers indicated that they used games like “chess”, indigenous games and gave extra classes. The following excerpt supports this statement.

**Teacher A:** *I conducted a lot of activities that relate to number sentences and geometric patterns by making use of various books and I sometimes used chess.*

**Teacher B:** *I normally use play games that are available to learners and play daily in my environment to explain certain concepts in number sense and geometry. This has been very fruitful to my learners to understand some basic concepts in mathematics and I will urge my colleagues to do same when teaching.*

**Question 3 (a): Do you incorporate the prior knowledge of learners when preparing your lesson plan?**

Both teachers confirmed that they made use of learners’ prior knowledge in order to make teaching effective. This is what they had to say:

**Teacher A:** *Yes, I incorporate it because it is very important to know their background.*

**Teacher B:** *Yes. I try to consider what the learners know about the concepts before I present them.*

**Question 3 (b): Please share briefly how you would normally approach a new or challenging concept to make sure you teach it effectively.**

The teachers indicated that they used practical activities in their classrooms. Teacher A indicated that she used teaching aids in the mathematics classroom. The excerpt below explains the views of both teachers:

**Teacher A:** *I use teaching aids to guide my learners in learning some concepts in number sentences and geometric patterns.*

However, Teacher B ensured that she was well-prepared and had discussed methods and approaches with other teachers to find the most appropriate ways of introducing a new or difficult concept.

**Teacher B:** *I gather as much information as possible from other mathematics teachers before presenting it to the class.*

**Question 3(c): Can you share with me the teaching methods you use when teaching number sentences and geometric patterns.**

The teaching strategies applied by teachers in the teaching and learning of number sentences and geometric patterns involved the traditional approach of teaching, whereby teachers do not use practical

activities to develop the understanding of the learners. The excerpt below further supports the statement.

**Teacher A:** *In most cases, I use chalk-and-talk... in the, flipped classroom to make my teaching and learning more interesting and understandable to learners.*

**Teacher B:** *In most cases, I use learner-centred approach through the use of technology.*

**Question 3 (d):** *What is your opinion concerning the use of a 'game approach' in mathematics when teaching number sentences and geometric patterns?*

As the teachers had not incorporated the use of games in the teaching of number sentences and geometric patterns, they were later given information about the use of games in the teaching and learning in mathematics. They were asked for their response to this approach:

**Teacher B:** *It is very good as it helps the learners to do maths on their own and also for learners to learn from one another. It helps a teacher to be able to plan their lessons for the learners according to their levels. It also helps stronger learners to explore information by themselves and to help weaker learners who are struggling.*

**Teacher A:** *The game approach in teaching and learning of geometric patterns and number sentences is a good idea mainly because learners will play attention to mathematics concepts in the game since learners like games.*

**Question 4 (a):** *Can number sentences and geometric patterns relate to real-life situations?*

The teachers did not seem familiar with relating the teaching of mathematics to authentic learning. The excerpt below gives us a better understanding of the views of the teachers.

**Teacher A:** *Yes, because in a real-life situation, such as washing their laundry, it involves measurement.*

One of the participants mentioned that he used chess in his classroom. However, both teachers could not think of any number sentence and geometric pattern concepts applicable to the game.

**Teacher B:** *Yes, I always use chess.*

**Question 4(c):** *Can learners learn any mathematical concepts using morabaraba?*

The curriculum encourages teachers to use indigenous games in their teaching and learning. However, teachers were not well informed about indigenous games such as *morabaraba*. Participant B indicated that he/she was not sure of the use of *morabaraba*. The excerpt below reflects their view:

**Teacher A:** *Yes, addition.*

**Teacher B:** *Not sure.*

## 8. Discussion of Findings

### 8.1. Barriers and Challenges faced by Teachers when Teaching Number Sentences and Geometric Patterns

The study revealed that a lack of mathematical content knowledge possessed by teachers contributes highly to the poor performance of learners. Teachers are not trained to develop teaching strategies suitable for the effective teaching of number sentences and geometric patterns. Teaching practices and the lack of basic content knowledge have resulted in poor teaching standards, as well as learners' poor performance in mathematics in the country. The study further revealed that the curriculum is based on foreign ideology, rather than on local ones, a notion supported by Deresky [1], who mentioned that education in South Africa is based on foreign ethics and values which learners find difficult to understand.

### 8.2. Methods currently used by Teachers in Teaching Mathematics in General

The study revealed there are various teaching methods that can be applied when teaching number sentences and geometric patterns. For example, the chalk-and-talk method is teacher-centred and focuses the use of the voice and blackboard which does not allow for the use of formal or informal activities in the classroom. In using a 'flipped' classroom, the teacher taps into technology and makes use of learning materials which allow for authentic learning. Learners may watch online lectures and presentations or demonstrations and it grants learners the opportunity to learn in their own time and manner and for the teacher to monitor and supervise the learning offering support and scaffolding when needed. A game-based approach involves indigenous games such as *morabaraba*. However, before the interviews, teachers stated that they use all the teaching strategies, but this was proven otherwise during the observation. In most cases, teachers in the classroom apply the traditional method of teaching, which is known as chalk-and-talk, a method known to deny learners the opportunity to relate to mathematics.

Douglas and Isherwood [48] advises that "teaching strategies comprise interventions used by a teacher to bring about student learning". This means that learning must have occurred as a function or a correlation of the instructional operations performed by the teacher. Pedagogical practice occurs when teachers facilitate learning for diverse learners to access knowledge, activities and

opportunities to develop skills by building on previous learning. The process begins when the learners respond to the teacher presentations and interactions and continues when the teacher facilitates the construction of new learning in a learner-centred manner. Teaching is a dynamic interaction among four components: the learner, the teacher, the curriculum, and the learned repertoire [49]. Therefore, the basic unit of pedagogy consists of the least divisible component of instruction that incorporates both learner and teacher interaction and it predicts a new stimulus of control for the learner. According to Surd et al. [50], “teaching is a complex act, and effective teaching involves a multitude of variables. Some of the variables one must consider involve children’s unique learning styles, a teacher’s teaching styles, physical classroom environment, community and school administration priorities and pressures”. In essence, one way of motivating learners is for the teacher to outline the importance of mathematics and its relevance to their future careers.

The approach to the teaching of mathematics requires skill, insight, dedication and hard work as well as time in and time out of classroom [51]. The chalk-and-talk teaching method has been used in countries such as China with Petre [52] reporting that “Minister tells schools to copy China - and ditch trendy teaching for chalk and talk: Teachers speaking in front of a class is much more effective than independent learning”. The chalk-and-talk method is believed to be effective for teaching certain topics such as number sentences and geometric patterns. However, countries such as the UK, US, Australia and New Zealand are moving away from the traditional methods of teaching to a more interactive approach that promotes collaborative teaching and learning which allows learners the freedom of learning with the teacher facilitating the process. The discovery approach is regarded as one of the effective teaching approaches specifically to assist learners to apply their prior knowledge involving their interests instead of memorising bonds, timetables and mental arithmetic. The study conducted in the UK “*What Makes Great Teaching*” [65] indicates that in order for learning to be effective, schools need to adapt to quality of instruction, which includes using strategies like effective questioning, the use of assessment and presenting information to students based on their preferred learning style, challenging students to identify the reason why an activity is taking place in the lesson.

The lecturing method may have positive and negative outcomes. The disadvantage of this method is that learners are individual with different learning styles and might not receive content the same way. However, lecturing method has been known to be valuable for explicit teaching which means that the teachers explains terms and it is simple way to cover

the pacesetter and instruct how learning should take place. In a flipped classroom, learners are in charge of their own learning, a method that has been considered effective. According to Milman [54], the approach is gaining in popularity, particularly in mathematics classrooms, where it has been reported that it provides for greater learner motivation and interest, as well as increased learner-teacher interaction. On the other hand, the game-based learning approach is an innovative learning approach derived from the use of computer games that possess educational value or different kinds of software applications that use games for learning and education purposes such as learning support, teaching enhancement, assessment and evaluation of learners. Chien, Wu and Hsu [33] states that the 4<sup>th</sup> Industrial Revolution (4IR) emphasises the need to use ICT in the classroom and this form of teaching assists learners in learning life skills through technology. However, this approach is not effective in remote or rural areas where learners are not familiar with ICT and are not connected to technology. Therefore, methods and approaches need to be adapted to make teaching relevant to learners in rural schools such as the introduction and use of an indigenous knowledge system.

### **8.3. Indigenous Games like Morabaraba used by Teachers in the Teaching of Number Sentences and Geometric Patterns**

Before classroom observation took place, teachers stated that they embraced the prior knowledge of learners in their lesson delivery. This is in line with the NRC Statement [36], which says that teachers need to ensure that prior knowledge of learners’ ability is considered to ensure effective learning. For instance, one educator mentioned that he uses chess in his class to link it to mathematical concepts. This is further supported by Ivy [38] who stated that the use of indigenous game in mathematics classroom “A game called *arauru* or *pada*, where a child balances on one foot and uses it to push a stone from one drawn rectangular box to the other help teachers in the teaching of the concepts of balancing and counting. However, the observation conducted by the researcher proved that the teacher still applied the talk-and-chalk method in his classroom. This contradicts the findings by Smith [34] when he indicated that, “good teaching is understood to involve a process of facilitating learning rather than being the simple transmission of knowledge from the educator to the learner”. Teachers need to apply or implement a hands-on and interactive approach to learning activities to allow learners to develop critical thinking skills. It was evident throughout the observation period that teachers were more concerned about pace setting rather than learners’ development.

The study revealed that teachers were not familiar with using indigenous games such as *morabaraba* to teach mathematics concepts. However, when the concept of using indigenous games was introduced, teachers noted that geometric patterns are associated with indigenous games like *morabaraba* which offers the opportunity to implement alternate methods and ensure that learners work with real life situations.

## 9. Conclusions and Recommendations

Initial teachers had little idea of the use of indigenous games in the mathematics classroom to teach number sentence and geometric patterns in Grade 4 until they were introduced to them by the researchers. They later confirmed that the use of indigenous games was good for teaching number sentence and geometric geometry patterns. Furthermore, the introduction of an indigenous knowledge system would assist teachers in applying indigenous games to make the teaching and learning of number sentences and geometric patterns enjoyable and understandable to learners.

It is therefore recommended that a comprehensive study to enforce the use of *morabaraba* to support the teaching and learning of mathematics in both qualitative and quantitative approach should be implemented immediately to seek the opinions of respondents regarding this topic.

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