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Research Article

Teaching number patterns through Kgati in a rural classroom

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This article explores the pedagogical potential of African indigenous games, focusing on Kgati, a traditional skipping game, for the teaching of number patterns in a Grade 4 rural South African primary school. The article is framed within ongoing conversations about the value of indigenous knowledge systems and the promotion of culturally responsive pedagogies that affirm learners' identities and local contexts. The theoretical ideas of horizontal and vertical mathematisation provided the basis for the study and are used to analyse the data, with horizontal mathematisation found to be the main feature of the observed Kgati-based lesson. This single case study, drawing on observational and video data collected from a mathematics lesson, investigates the way in which indigenous games can enhance mathematical understanding and learner engagement. A total of 14 teachers were involved in the project, but only one teacher's lesson is reported on in this article. The findings reveal that learners respond enthusiastically to the incorporation of Kgati, displaying enjoyment and participation. However, the study also highlights a gap in transferring these informal skipping activities to formal written tasks, where some learners continued to struggle with abstract representations and the associated terminology of number patterns. It is recommended that teachers use Kgati and other indigenous games not only to introduce lessons but as a rich source of material for more abstract levels of mathematics, creating stronger links between the game and formal curriculum content.

Keywords: Counting; Emergent modelling; Ethnomathematics; Horizontal mathematisation; Indigenous games; Number patterns; Realistic mathematics education

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1. Introduction

The use of indigenous knowledge in education has become a priority in countries such as South Africa. One prevalent theme is the integration of ethnomathematics into pedagogical frameworks designed to enhance students' numeracy and mathematical problem-solving abilities (Utama et al., 2023). Through ethnomathematics, teachers connect mathematical concepts with learners' existing cultural knowledge, values, and local practices, making formal mathematics more closely related to their everyday experiences (Bukari, 2026; Kabuye Batiibwe, 2024). This cultural contextualisation fosters motivation and enhances students' engagement, particularly in marginalised communities (Rosinansis et al., 2022). More importantly, perhaps, ethnomathematics creates a democratic environment in which the decolonisation of mathematics finds expression, and in which learners perceive their daily lives and their culture as being 'mathematical', which

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can assist to restore and reaffirm the dignity of learners (D'Ambrosio, 2001). Studies have shown that ethnomathematics approaches are embedded in social constructivism, in that they recognise the everyday knowledge that learners bring into the classroom (Laridon et al., 2005) and enhance learning through social interaction (Sabon & Telussa, 2024; Turmuzi et al., 2024). Indigenous games, specifically, can bolster learners' enthusiasm and demystify mathematical concepts by rooting them in familiar cultural practices (Meeran, 2024). They also help establish connections between abstract concepts and concrete practices (Mosimege, 2020). Many studies report on enjoyment, enthusiasm and improved motivation when ethnomathematics approaches are used. Abioye et al.'s (2024) findings demonstrate that indigenous games enhanced children's foundational mathematics knowledge, suggesting that 'those who engage in these activities perform better in mathematics than their peers'. Similar findings have also been reported in the Philippines (Balbawang & Felix, 2023).

Indigenous games can be harnessed to teach mathematical concepts. Kgati is a skipping game in which players skip and count to a pre-determined pattern. Counting sequences follow patterns that represent the structure underlying our number system (Franke et al., 2018). Learners' abilities to notice number patterns when counting in sequence can be enhanced when the whole body in involved, as in the Kgati skipping game. Furthermore, the skipping activity is an already known aspect of many children's cultures; it therefore assists in bridging the known to the unknown.

The purpose of this article may be expressed as one of the objectives of ethnomathematics; that is, '[to look] for possibilities of improving the teaching of mathematics by embedding it into the cultural contexts of pupils and teachers' (Gerdes, 1995, p. 7). Van der Walt et al. (2019) confirmed that ethnomathematics enables learners to connect abstract mathematical concepts to cultural representations within their context, enabling them to understand the mathematical concept being taught. Tangkur et al. (2022) confirmed that very little literature exists on using indigenous games for teaching mathematics. This article focuses on the adoption of Kgati (skipping), a cultural recreational activity, in enhancing mathematics learning for Grade 4 pupils, specifically through counting, playing and explaining mathematical concepts. The article shows how primary school teachers can use indigenous games to enhance mathematical comprehension.

The article seeks to answer the following research question:

RQ) How do primary school teachers use indigenous games to enhance mathematics understanding?

2. Review of Related Literature

Mathematics has always been presented with a strong Western epistemological slant (Olawale, 2025). By including diverse cultural knowledge in the exploration of mathematical concepts, educators can help to dismantle this Western hold on mathematics and facilitate the emergence of, and appreciation for, indigenous mathematical expression. Disconnects between learners' own worlds and mathematical concepts can alienate learners from mathematics. Furthermore, teaching methods that favour individual and rote learning may widen the gap between African learners and mathematical concepts, even though these concepts are visible in their cultural artefacts and knowledge. Olawale (2025) adds that integrating 'indigenous counting systems, traditional geometric methods, or culturally specific problem-solving techniques can enable pupils to recognise the significance of mathematics in their lives and communities' (p. 2).

2.1. Using Indigenous Games for Teaching

Using surrounding cultural phenomena to teach mathematics is important because it can reduce the gap between formal mathematics and mathematical contexts that students understand (Prahmana & Istiandaru, 2021). D'Ambrosio (1994) stated that ethnomathematics acknowledges that there are different ways of doing mathematics, including the academic mathematical knowledge developed by different sectors of society, and the various cultural modes in which cultures negotiate their mathematical practices. Bishop (1990) set out six universal mathematical

activities that apply in all cultural groups: counting, locating, measuring, designing, playing and explaining. Since all cultures capture these six mathematical activities, it follows that cultural artefacts closest to the learner should be used in educational contexts. Moloi (2020) synthesises research that recognises indigenous knowledge as foundational to understanding learners in the rural context. According to Moloi (2020), to enhance mathematical conceptualisation, it is essential that the indigenous games rural learners play on a daily basis are infused into the learning of mathematical content.

Using indigenous games is one way to harness indigenous knowledge. Orth (2018) acknowledges that besides being fun, these games have significant value in promoting physical abilities, communication skills, teamwork and cognitive skills. For Mosimege (2020), UNESCO's digitisation of local traditional games has helped raise public awareness and has boosted the preservation of traditional knowledge. Public awareness of the value of these games can help promote their creative use in classrooms. Vankúš (2008) acknowledges that learners' active involvement during games is important for their comprehension of the mathematical knowledge embedded in the games. Games have the potential to demystify mathematics as an abstract and challenging course of study (Nabie, 2011). More holistically, Abioye et al. (2024) highlight the cultural significance of these games in reinforcing identity and promoting a sense of social cohesion. These scholars lament that 'despite these benefits, there is a noticeable gap in integrating indigenous games into formal educational settings' (p. 142). This study hopes to be part of a scholarship to address this gap.

Using indigenous games to teach mathematics means that learners are playing but learning at the same time. According to Moloi (2020), interaction amongst learners happens spontaneously when playing games, which assists to alleviate mathematics anxiety. In a study by Moloi et al. (2021), Kgati was used to teach mathematics word problems to Grade 4 pupils. The findings indicate that learners could interpret, convert and link their indigenous knowledge with mathematics, with the practice improving their understanding of mathematics concepts. Furthermore, Meeran (2024) found that teachers were able to integrate Kgati into a number of mathematics topics.

3. Theoretical Framework

Realistic Mathematics Education (RME) theory provided the foundation for this study. The first aspect of RME is its distinction between horizontal and vertical mathematisation. Horizontal mathematisation refers to moving from a realistic or situational context to a mathematical representation of the problem. Freudenthal (1991) calls this 'moving from the world of life to the world of symbols'. For example, a teacher might present a mathematical word sum such as, 'There is a bus with five people. Two people get off the bus at the first stop, and one person gets onto the bus at the next stop. How many people are on the bus?' This word sum, drawn from 'the world of life', makes it possible for learners to move from a 'real' situation to a mathematically expressed equivalent, i.e., '5–2+1'. Thus, the word sum enables the articulation of horizontal mathematisation.

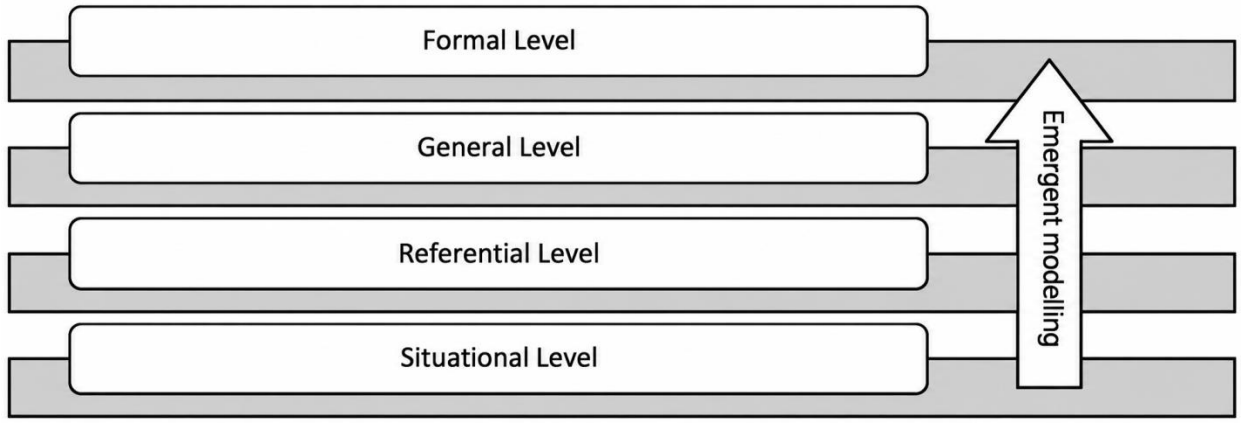
However, when learners move within the abstract levels of mathematics itself, they are practising vertical mathematisation; for example, when they understand that adding two and multiplying by two do not necessarily result in the same answer. Gravemeijer (1994, p. 94), describes the reinvention process in RME, explaining that vertical mathematisation takes place when learners' informal descriptions of problem situations develop into mathematical language, and they start shaping algorithms and abstracting and understanding symbols from situations. With horizontal mathematisation, learners move from the real world to the world of mathematics; with vertical mathematisation, learners move within the world of mathematics and are able to understand more abstract concepts. Another important aspect of mathematising is that during optimal learning, students reflect on their own activities (Freudenthal, 1991). Moloi et al. (2021)

found that with the use of Kgati, learners 'can mathematise because they are able to use and unearth mathematical content embedded within Kgati' (p. 243).

A further tenet of RME is Gravemeijer's notion of emergent modelling. Gravemeijer (2002, p. 2) distinguished between early models that learners create of a contextual situation and later, more abstract, decontextualised models. The early, intuitive model of a contextual situation can later function as a model for more formal mathematical reasoning. Thus, the contextual model of skipping and counting while skipping can become a model for understanding more advanced mathematical patterns. Gravemeijer (1994, pp. 101–102) states that emergent modelling begins with a real situation, followed by the formation of a model of the situation, followed by a more abstract model that gives rise to formal knowledge. He identifies four sequential hierarchical levels (see Figure 1): the situational level, where students work within the context of the problem (e.g. skip counting); the referential level, where their models refer to the situation (e.g. noticing that counting in twos is the same as +2); the general level, where the mathematical focus is on strategies that govern the reference to the context (e.g. noticing that +2 is not the same as x2); and the formal level, where students work with conventional procedures and algorithms (e.g. formal number pattern problems).

Figure 1

Levels in emergent modelling



Note. Adopted from Gravemeijer (1994, p. 102).

Gravemeijer et al. (2000, p. 241) explain that teachers can formulate a proposed trajectory for the classroom so that learners first model a situation in an informal way (e.g., skip counting in twos) and then mathematise their informal activity to produce a model for their reasoning (2+2=4; 4+2=6; 6+2=8). At the first level, learners are active within the task setting (skipping). The next level requires a referential activity, with the learners' model grounded in their earlier experience of the situation. At the third level, students are involved in a general activity where they lose the dependency on the situation (skipping); and at the fourth level, students can reason using conventional symbolisations (2; 4; 6; 8 as a pattern is +2 or n x 2).

Peni (2021) explains that ethnomathematics principles in emergent modelling can take three forms: ethnomathematics as context, ethnomathematics as a tool for mathematisation, and ethnomathematics as a value-driven concept. Ethnomathematics as context refers to using contexts that are relevant in the daily lives of learners as a basis for mathematical problems. Ethnomathematics as a tool for mathematisation refers specifically to working mathematically within the context or using a cultural artefact to link mathematics to the real world of learners and to develop more abstract mathematical ideas (i.e., working within mathematics itself). Ethnomathematics as a value-driven concept encompasses a holistic understanding of the value that culture brings to the mathematics education landscape.

This article explores how indigenous games used in a rural school in Limpopo contribute to these conceptualisations of ethnomathematics. In order to do this, it was important to visit classrooms to explore how teachers were integrating indigenous games into their lessons.

4. Method

4.1. Research Design

An interpretivist, qualitative case study design was followed that included non-participatory observations and a semi-structured interview. Observations allow qualitative researchers to gather in situ data that is often more valid and authentic than data collected in other forms (Cohen et al., 2019). The researcher was a non-participant observer in the lesson. An interview with the educator after the lesson allowed the researcher to probe the educator's thoughts, reasons and challenges. The interview was informal, and the questions emerged from the immediate context. According to Patton (1980), in informal interviews there is no predetermination of question topics or wording. The interview in this case did not take more than 20 minutes since the educator was needed in the classroom for a lesson.

4.2. Participants

The educator in this study was part of a group of 14 teachers in a rural area of Limpopo who participated in a project on the use of indigenous games to teach intermediate phase mathematics. Ethical clearance for the project was granted (2020/09/09/90441435/10/AM), along with permission from the provincial department and the principals of the participating schools. Fourteen schools were selected from one circuit since the district official expressed an interest in the project, with all schools relatively close to one another. The 14 teachers who participated in the project had attended a one-day workshop on the use of indigenous games earlier in the year. One school was sampled for this study, since the teacher indicated a willingness to be observed as she tried to teach mathematics to her Grade 4 learners through an indigenous game. Being assured of confidentiality in the reporting of her lessons and thoughts, she gave her consent for the lesson to be recorded.

4.3. Data Collection

The lesson, lasting about 40 minutes, was video recorded and transcribed. After the lesson, the researcher held a short interview with the teacher to discuss aspects of the lesson. The classroom was neatly laid out with desks and housed 40 learners. There was a chalkboard but little other visual stimulus. The observation was guided by an observation tool that reminded the researcher to look for indigenous game use and its link to mathematics concepts.

4.4. Data Analysis

The transcription of the recorded lesson, informed by findings from the interview, was thematically analysed, with the themes presented via a chronological narrative of the lesson. RME as the theoretical framework was employed during analysis of the lesson, as was the concept of emergent modelling. The researcher read the lesson transcription several times to remind her of what had been observed during the lesson. During the second and third readings, data was coded according to the various ways in which the teacher incorporated Kgati into different phases of the lesson. The analysis is presented as the lesson trajectory unfolded and transcripts were coded for: use of indigenous game, instances of vertical and horizontal mathematisation and evolution of emergent modelling.

5. Findings

The findings are presented in chronological order as they occurred in the lesson and are explained in light of the principles of mathematisation and emergent modelling.

5.1. Lesson Phase 1: Using indigenous games to create interest

The teacher started the lesson by introducing the topic for the day and handing out the worksheets that students would complete after a skipping session outside.

T: Now, I am giving you a worksheet and you're going to complete it after you play. You're going to have fun today … Right, let's go outside and go play. ... I am going to show you how to skip patterns of two.
[Two learners turned the rope, and the teacher skipped, counting as she did so.]
T: 1,2, and next comes … 3,4.
Learners (chanting): 1,2; 3,4; 5,6; 7,8; 9,10, … [until 19,20].

At this point, the teacher was using Kgati as a fun way to introduce patterns. Patterns are seen as an extension of counting, in this case a counting sequence of 1 to 20.

5.2. Lesson Phase 2: Teaching along a trajectory

The teacher used Kgati to guide her teaching and learning. Having counted in twos, the teacher now got the learners to skip and count in fours.

T: Now we count in 4's
T: Jump 4 times and then you go out and the other [learner] comes in
Learners: 1,2,3,4
T: then - 5,6,7,8
T: [counting as the learner jumps rope]: 9,10,11,12
T: Aha – what number is coming next?
T: After 12, comes what?
Learners: 13, 14,15,16,
T:16, very good
T: aha – that is counting in 4's

Here the teacher emphasises the 4th number e.g. 12, 16 and not the counting to reach the 4th number. The teacher also starts and ends this sequence by indicating that they are 'counting in 4s' to link the skipping to the pattern 4,8,12,16.

When the teacher moved to counting backwards in 3s – the skipping did not provide much assistance, and they found this more difficult.

T: Ok, let's count backwards in 3's
T: if we count backwards from 21, where do we go?
T: 21,20, 19… then…
L: [no answer]
T: 19,18,17
Ls: [talking amongst themselves, not sure of the answer]

In this excerpt of 'counting backwards in 3's', the learners are unable to answer the teacher and the skipping itself does not assist them with finding the next number in the pattern. The teacher may have considered getting the learners to skip in the opposite direction into the rope to show a backwards counting movement.

In the post-lesson interview, the teacher was asked about the extent to which she used skipping in the lesson.

T: Yes, that they could not get in [the skipping], but all in all, it was fun for them. We will try to get better.
R: So, specific challenges that you experience when you integrate indigenous games with your teaching – your resources, size of class, the time?
T: The resources we have a lot of that, but time. There is a lot of them [learners], and if you want to get everyone to participate as we should … but time does not allow – a period is only one hour and if you are skipping, you have to give different examples. But if you're going to get every learner to do it, then the period will be over! And you are not able to finish the whole lesson.
R: But if you had 10 ropes, that would help?
T: Oh, yes.

In this phase of the lesson, the teacher used ethnomathematics for context and as a tool for horizontal mathematisation while implicitly positioning Kgati as a value-driven concept, i.e., she demonstrated that the indigenous game of Kgati has value to mathematical thinking and learning.

This is one of the aims of ethnomathematics. The lack of resources clearly affected the pace and learner involvement in the lesson.

5.3. Lesson Phase 3: Moving from skipping to pattern rules

The teacher and learners returned to class, much to the disappointment of the learners, where they started filling in the worksheet. The first three tasks on the worksheet incorporated the same concepts as their skipping outside, i.e., counting in two, threes and fours.

> T: Take your worksheet. You're going to jump: 1, 2. [Teacher jumps while saying this.] Then 3, 4, then 5, 6.
> T: Fill in the missing number there
> T: You can do pattern no: 1,2, 3 and 4

For the first three tasks, the teacher modelled the integration of the skipping activity with the worksheet. The teacher clearly tried to bridge the game of Kgati with the worksheet activity, where the counting and patterns were identical, thus bringing in the referential level.

With Question 4, she added complexity in the following way:

> T: The rule says that you must add consecutive natural numbers. Consecutive natural numbers … what are they?
> [Silence]
> T: What do you do to 1 to get a 3? Anyone? Karabo?
> Karabo: You add 2.
> T: [affirms] You add 2. To get a 6 you must do something to 3. 3 plus 3. The next consecutive number is?
> Karabo: 4
> T: 6 add 4 is? 10.

In the except above, the teacher was getting the learners to deduce the pattern 1,3,6,10 by adding consecutive numbers. She made no specific reference to skipping here. She assisted Karabo in understanding what 'consecutive' numbers meant by asking for what must be added to 1 to get 3. In this case, Kgati was not used in either situational level nor referential level of emergent modelling.

In the post-lesson interview the researcher asked: 'Do you start with the curriculum document, and then look for the game that matches it, or do you start with the fact that you know these games, and you can identify the mathematics in there, and then go to the curriculum document ... or is it both?'

> T: I start with the curriculum, then look for the indigenous game that matches it.

The teacher used the curriculum content as the starting point and then used the game to introduce only that specific content, instead of reflecting on the game itself and determining the many aspects of mathematics that could be taught using the game. Although many games are known in this community, specific mathematisation of these games needs to be further developed. This may be a challenge when indigenous games are not appreciated or given epistemic value owing to attitudes inherited from colonisation.

5.4. Lesson Phase 4: Moving to word problem patterns

Towards the end of the worksheet the teacher included a few number patterns in the form of word problems. These types of problem are usually considered difficult for learners (Malik & Rezat, 2022). Here again, she did not use the skipping to model word problem situations. The problem situations on their worksheet required both horizontal and vertical mathematisation in progression. Regarding emergent modelling, these problems were situated at the General level, raising the level of abstraction required.

> T: Ok, how many stickers would Flora have collected by the end of the week? Day 1… how many stickers?
> Learners [chanting]: 5
> T: You have Day 1… 5 stickers. Then day 2 is 8 stickers.

T: How do we get 8? … Add 3 more stickers.
Day 2 you collect again, you add 3 to the previous. 8. (5+3=8).
Day 3?
L: 11 (chorus)
T: 8 plus 3 is 11. Day 4 is 11 plus 3, is 14. Now you do the rest of the days.

The teacher was teaching a number sequence where a constant of 3 had to be added. So, the number pattern is 5,8,11,14. The teacher specifically showed the learners that adding three to each number would get them the sequence. She specifically helped them with horizontal mathematisation (going from the word problem about stickers to the mathematics it was depicting) helping them move from situational model to referential model, but without explicitly teaching it or modelling how she got to pattern.

Table 1 presents the lesson phases according to the theoretical framework.

Table 1
Lesson phases according to the theoretical framework

Lesson phase	*Theoretical idea*	*Example*
Phase 1	Horizontal mathematisation Situation level emergent modelling	Skipping and counting in various patterns (+1 or in twos)
Phase 2	Horizontal mathematisation Referential level emergent modelling (referring to skipping while counting in 4s)	*Now we count in fours …Jump four times and then you go out, and the next one comes into the rope.*
Phase 3	Horizontal mathematisation	Teacher jumps in class to match the worksheet to the skipping Adding consecutive numbers
	Vertical mathematisation Formal level emergent modelling	Moving directly to formal mathematics "adding consecutive numbers" without reference to skipping activity.
Phase 4	Horizontal mathematisation	Word problems dealing with collecting stickers
	General level of emergent modelling	Once learners knew that the pattern was to add 3, they continued with the rest of the numbers by simply adding 3.

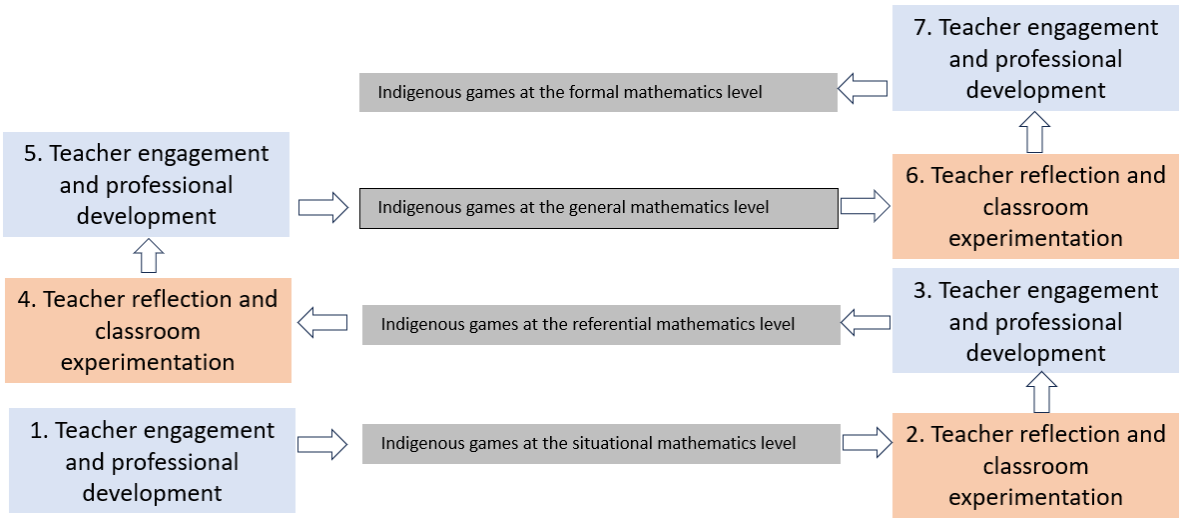
The possible trajectory of teacher professional development in Figure 2 is also based on emergent modelling. In this way the theory is relevant both to the data and to express a possible path in teacher learning.

Teachers start at point 1 but engaging in professional development on the use of indigenous games to teach mathematics. Teachers implement the use of games in their classrooms, and this forms the situation level of emergent modelling for teachers. It is through teacher reflection on using the games during subsequent professional development sessions that they may enter the referential level of emergent modelling i.e. they will refer to the games and develop increased knowledge of using indigenous games. This may lead to another session of teachers experimenting with indigenous games and further reflection. This reflection is part of further professional development sessions, and this may ultimately lead teachers to both general and formal levels (through iterative classroom experimentation, reflection and discussion during professional development).

Figure 2 presents a hypothetical teacher development trajectory for teaching with indigenous games. At this point in the project, teachers had one full day workshop on teaching with indigenous games and during these observations, they were trying this out. The teacher is already reflecting on the inclusion of the game in teaching, and this will enable richer discussions during the next professional development session. Since the teacher in this study largely spent time using Kgati at a situational and referential level, it is anticipated with more professional development

sessions, the teachers will elevate their use of indigenous games to both general and formal mathematics levels. Seeing the mathematics in the games will be a critical point.

Figure 2
Hypothetical teacher development trajectory for teaching with indigenous games



6. Discussion

6.1. Lesson Phase 1

The teacher used the terms 'fun' and 'play' to indicate that the learners would enjoy the lesson. Burdack and Schöllhorn (2023) showed a positive link between skipping and arithmetic performance. Interestingly, these scholars state that skipping combines cardiovascular exercise with co-ordination and includes an element of rhythmic repetition. The teacher gave many learners a turn to skip, changing the grouping of numbers occasionally, as described in Phase 2. A progression from easy to more demanding counting activities was observed. During this phase of the lesson, the teacher and learners were operating at the Situation level of Gravemeijer's emergent modelling. The teacher moved from the 'real-world' (i.e. skipping) to the 'mathematical world' (horizontal mathematisation) of counting and patterns, showing evidence of horizontal mathematisation. The teacher also encouraged the learners to use the language of mathematics while playing the game (Hadebe-Ndlovu, 2022). This assisted the teacher to note their understanding of the underlying concept.

6.2. Lesson Phase 2

The teacher used the skipping activity to reinforce counting in groups. However, she did not bridge the activity to more formal notations of number patterns or use formal mathematics terminology during the skipping sessions. Thus, she did not use the skipping for reflection, which might have raised the emergent modelling to the referential level. Instead, she kept the skipping activity based, or at Level 1 of Gravemeijer's emergent modelling. The teacher could have used the skipping to deepen understanding of grouping numbers in sets of two, four, or three, but she skipped the Referential level, moving to the General level. Thus, a conceptual bridge was missing in the sequence of events. The use of Kgati for horizontal mathematisation is evident, but using Kgati for vertical mathematisation is more challenging.

Bose and Seetso (2016) found that many teachers do not realise that everyday games may be harnessed for teaching science and mathematics concepts, and that many lack the pedagogical knowledge to use play in teaching. In this case, the teacher used Kgati only to introduce the topic but was unable to explicitly build conceptual models of number patterns onto the activity. It was also noted that not every learner was able to participate in all the skipping activities, since only one rope was used. This diluted the value of the activity for the majority of learners.

6.3. Lesson Phase 3

What is evident in Lesson phase 3 is that the teacher was moving to more abstract and advanced number patterns (vertical mathematisation) in which the skipping no longer formed a reference point. The learners had left the situational level and may or may not have reflected on the skipping activity to support their building a model of the number pattern now being taught. A possible reason for the teacher's use of the skipping game only as an introduction and not as an integral part of the entire lesson may have been the way she conceptualised the game. Kgati was part of the implicit situational level in Phases 1 and 2 and was used referentially in the first few worksheet activities; in the third phase, although no longer serving as a reference point or context, Kgati may nonetheless have served implicitly as a tool for mathematisation. The mathematics language or terminology used during this part of the lesson (focusing on 'consecutive' numbers) may have contributed to learners' difficulties in understanding the question.

Research in an Australian primary school illustrates how traditional Indigenous games can support students' understanding of cultural practices and their significance (Dinan-Thompson et al., 2014). In the present study, however, learners' participation in Kgati also highlighted the need for explicit connections between the cultural activity and the mathematical ideas addressed in subsequent classroom tasks. Tachie and Galawe (2021) state that this has led to silence on the use of indigenous games in the teaching and learning of mathematics. There are very few resources for teachers, and the curriculum document does not propose the use of indigenous knowledge. The word 'indigenous' is only mentioned once in the curriculum document, under the general aims of the curriculum: 'Valuing indigenous knowledge systems: Acknowledging the rich history and heritage of this country as important contributors to nurturing the values contained in the Constitution' (Department of Basic Education [DBE], 2011, p. 5). Hadebe-Ndlovu (2022) elucidated the known challenges of integrating indigenous games into mathematics teaching; namely, lack of specialised knowledge, books, resources and technology.

6.4. Lesson Phase 4

The teacher scaffolded the learning by going through the word problem step by step with the whole class. She modelled the translation from words ('Flora gets three more stickers each day') to mathematics (+3). At this point of the lesson, she did not refer to Kgati or the fact that they had just used this number pattern in skipping, thus omitting a bridge that could have proven useful for linking the activity to formal notation (horizontal mathematisation). Freudenthal (1991, p. 18) made a strong argument for what he called 'mathematics starting and staying in reality'. It is generally known that teachers are reluctant to use play pedagogy in teaching (Van der Walt et al., 2019), partly because of conventional beliefs and orientations. although teachers recognise the value of play-based pedagogy through African games, systemic barriers including curriculum constraints, limited resources and insufficient professional development impede consistent implementation, and that teachers expressed uncertainty about game mechanics and how to integrate them into structured learning (Selepe & Mphahlele, 2025). Ernest (1989) maintains that traditional ways of doing mathematics plagues many mathematics lessons, not only those based on indigenous games.

In effect, the teacher reflected only part of the trajectory of indigenous game use in the classroom shown in Figure 2, in that she made use of the game only in Phases 1 and 2 of her lesson) of a hypothesised trajectory. The trajectory is supported by continual teacher professional development that is grounded in teachers' reflection on indigenous games, with each activity followed by reflection that leads to the development of better and more refined activities. A case study of Kgati in Intermediate Phase classrooms in KwaZulu-Natal reports that the game generates high learner engagement, but that teachers need training to identify the mathematical principles embedded in it (Meeran & Niranjan, 2026). Bottom of Form

In summary, Kgati functioned as both situation and referent levels in Phases 1 and 2, where horizontal mathematisation was sustained by the learners' rhythmic, embodied experience of

counting in twos and fours. From Phase 3, Kgathi ceased to serve as a reference point: the teacher introduced consecutive numbers and, later, the sticker problem without returning to the game, so that the model of skipping was never reconstituted as a model for reasoning about number patterns. The lesson thus reached formal notation without having passed through the general level. Each ascent through the levels in the hypothesised trajectory may need to be mediated by a cycle of professional development followed by classroom experimentation and reflection. The teacher in this study enacted steps 1 and 2 of the trajectories with evident skill and enthusiasm. We are reminded that the curriculum names indigenous knowledge once (DBE, 2011, p. 5) and offers teachers no worked account of how a Kgathi might be carried across the levels of emergent modelling.

7. Implications for Future Practice

The implications of this study for further practice are significant. First, professional development programmes should be designed and disseminated to capacitate teachers on using indigenous games in the mathematics classroom. This includes training in both the cultural context of the games and the mathematical concepts inherent in the games. Second, there is a need for collaborative platforms, such as workshops or digital repositories, where teachers can share lesson ideas, experiences, and strategies for integrating indigenous games into the mathematics curriculum.

Most educators, such as the teacher observed in this study, know the importance of grounding lessons in the lived experience of learners. However, the challenge with using indigenous games is to ensure that all aspects of the game are fully exploited during the lesson to convey mathematical concepts and are not used merely to start the lesson. Despite some gaps in this regard, the teacher in this study had sufficient pedagogical content knowledge and knowledge of the indigenous game to teach the mathematics inherent in the game. This teacher is a pioneer in the field of using indigenous games for teaching mathematics in South Africa. Going forward, this teacher (and the others in the project) should be encouraged to share her practices with other teachers. Teachers need to be developed further so that indigenous games may be mathematised to more abstract levels.

The curriculum itself should include a more formal focus on indigenous games, to advance culturally relevant pedagogy, supported at the policy level. This approach could enhance learner engagement, especially among learners who see their cultural practices reflected in the classroom. It may be one way of teaching diverse classrooms of learners about one another's culture.

Finally, involving local communities in the documentation and explanation of these games could enhance the learning experience for learners while also preserving cultural heritage. This collaboration might also foster a sense of ownership and pride among learners, making mathematics more meaningful and accessible.

8. Conclusion and Recommendations

Mosimege (2003) cautions that indigenous games should not be perceived narrowly, as merely a way of enhancing lesson enjoyment, but be seen as a useful resource for learning mathematical content. This article set out to explore how one teacher used Kgati to teach Grade 4 number patterns at a rural school in Limpopo province. High learner enjoyment and participation was evident during the lesson. The teacher used Kgati at the situational level but missed opportunities to incorporate it more deeply at the referential, general and formal levels. Nonetheless, the incorporation of the game had value in that it created a foundation of engagement in counting and number patterns. The teacher moved to general and formal levels of number patterns via a prepared worksheet. Part of her challenge was a lack of time and resources that would allow all learners to engage in the skipping activity. She did, however, increase the mathematical difficulty of the skipping activity. Had she had more time, this aspect could have been more fully exploited

and built upon in the lesson. The formal work prepared by the teacher progressed from easier to more advanced patterns, ending with word problems.

Although the teacher and learners are aware of indigenous games from their own culture, more input is needed to link these cultural ideas to mathematical concepts. Kabuye Batiibwe (2024) states that mathematics teachers should engage in strategic and structural planning of an ethnomathematics approach in their teaching. However, teachers should not bear the responsibility alone; valuing and using indigenous games and the ethnomathematical approach in general requires awareness and commitment among communities, policy makers and the entire scholarly community.

Teachers should be engaged with high quality, impactful professional development that focuses exclusively on indigenous games. This will assist them in preparing lessons that incorporate emergent modelling and vertical mathematisation based on indigenous games. According to Sunzuma and Maharaj (2020), teachers should be actively involved in designing culturally contextualised mathematics instruction rather than serving merely as implementers of the curriculum.

Future studies in this field are needed. Longitudinal studies on learner outcomes of using the ethnomathematics approach would be valuable, as would comparative studies examining the mathematical potential of different indigenous games. Studies could also focus on the development of teaching resources and frameworks. Ethnomathematics has the potential to improve mathematics teaching on many fronts. It serves as a way for students to master both horizontal and vertical mathematisation, creates a meaningful context for mathematisation, and serves as a value-driven practice. All cultural artefacts are, in fact, mathematically rich and can be creatively used in mathematics classrooms.

Data availability: The datasets generated and/or analyzed during the current study are not publicly available due to ethical and privacy considerations but are available from the corresponding author upon reasonable request.

Declaration of interest: The author declares that there is no conflict of interest regarding the publication of this article.

Ethics Declaration: Ethical approval for the study was obtained from the University of South Africa (UNISA), College of Education Research Ethics Committee (CEDU REC) (Approval No. 2020/09/09/90441435/10/AM), on 26 September 2023. The approval was valid until 26 September 2026. The study was approved in accordance with the UNISA Policy on Research Ethics and the institution's research ethics procedures.

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