DISRUPTIVE FIXATION: AN ANALYSIS OF ETHNIC GAMES AND LANGUAGES THAT ACT AS BARRIERS TO GIFTED EDUCATION IN SOUTH AFRICA

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Abstract

In the wake of the fourth industrial revolution, mathematics has come to dominate expectations regarding what counts as successful schooling in South Africa and elsewhere. Triggered by the continued dismal performance in mathematics on the many international competitions, in 2001 cabinet launched the National Strategy for Mathematics, Science & Technology. It was hoped that an adequate supply of matric graduates with mathematical sciences could be better assured by identifying mathematically gifted youth and nurturing them in hundred dedicated schools rather than through a dilution of effort across the whole schooling system. Experts in developmental issues would describe this as morally correct, educationally sound, economically beneficial and politically shrewd. Despite the wisdom behind the strategy, two decades later the dedicated schools project still failed to deliver to expectations. This paper locates the country's mathematics crisis within the functional fixedness or disruptive fixation theory. Fixation happens when for example a problem solver uses a well-learned procedure on a problem for which the procedure is inappropriate. With specific reference to classroom instruction, one form of disruptive fixation is evident in the way home languages and games have been dragged into the fray and couched as giving learners epistemological access to mathematical knowledge. For example, in a traditional game known as morabaraba, researchers claim that a number of mathematical concepts are present. In this paper I take a critical analysis of such claims. Borrowing from MacGillivray's three levels of mathematical capabilities as my analytical tool, the analysis shows how each of these concepts have been imported by the researchers into a game where otherwise the participants do not even realise that they are doing mathematics. In a few instances where mathematical concepts are evident, they are of a rudimentary nature which cannot be generalised as skills needed in the knowledge-based economy. Other studies done with various ethnic games have also concluded that most mathematical concepts proposed by ethnomathematics researchers were imposed from without and were

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concepts which were only intelligible to the relatively small number of people with a university-level education in contemporary pure mathematics. This paper then concludes by proposing that stakeholders should not stop challenging long-standing claims proffered by those in favour of the use of the learners' home languages and traditional games for teaching and learning. After all the national strategy was clear that it was important to strengthen the teaching of English second language.

INTRODUCTION

Although education has many objectives which vary from one country to the other, there is a global convergence into two commonly espoused objectives; that of expanding access (social equity) and that of developing skills needed by society in a modernising economy (human capital development). Within these debates regarding skills for the knowledge-based economy [KBE], there is a strong belief that such skills are going to be built on a strong foundation in Science, Technology, Engineering & Mathematics [STEM] – herein referred to as mathematical sciences. For this reason, ensuring an adequate supply of STEM skills is at the heart of many governments' strategies for innovation and productivity. However, in South Africa reports by Statistics South Africa (StatsSA), National Planning Commission (NPC), Department of Education (DoE), Department of Basic Education (DBE) and Department of Science & Technology (DST) all point to a serious shortage of such skills. In 2015 the Government of National Unity's [GNU] DBE minister, Angie Motshekga, reiterated that during apartheid learners who were capable of becoming accountants, engineers, actuarial scientists, pharmacists, medical doctors, and other professions [including teachers] requiring mathematics as a prerequisite, were denied the opportunity to fulfil their dreams. The department reaffirmed its commitment to eradicating that legacy of Bantu Education - a sign that authorities wanted to make a renewed undertaking to do something again, especially so as to strengthen or confirm it. In the case of mathematics education, the initial commitment had been made earlier when stakeholders launched a National Strategy for Mathematics, Science and Technology Education (NSMSTE) in 2001. At that time the GNU's vision was that of a scientifically literate, technologically fluent and numerically or mathematically literate society that empowered individuals to participate in the emerging KBE and supported sustainable development. In pursuit of that vision, the Council of Education Ministers (CEM) argued that learners with exceptional potential [gifted] were to be identified from previously disadvantaged communities and nurtured in hundred dedicated schools, later known as the Dinaledi Schools Project (DSP). This was further reiterated in the DBE base document that guided discussions on a new mathematics, science and technology (MST) strategy for South Africa. Therein DBE (2012) argued that the "obvious solution" to the mathematical science crisis was to provide additional learning opportunities for exceptionally gifted children and youths from previously disadvantaged backgrounds.

PROBLEM STATEMENT

Although it was hoped that the DSP would be able to overcome the perennial crisis in mathematical sciences, statistics still show that in the last three decades post democracy, the challenge that keeps nagging each and every newly elected government leadership from Mandela, Mbeki, Zuma and Ramaphosa, is the vicious cycle caused by the perennial deficit in enrolment and performance in mathematical sciences. In South Africa [and many other colonies] continued failure of many interventions is attributed mainly to a philosophy of mathematics education characterised by Badcock (2015) as emotional appeals to apartheid that have (1) paralysed rational thought (2) replaced scientific reasoning with political expedience and (3) directed arguments against apartheid rather than the facts. In Zimbabwe for example, the book Animal Farm has recently [2023] been translated into Shona to demonstrate how people get caught up in emotional appeals to notions of oppression and democracy. In many African colonies, even bad weather is blamed on apartheid. It is against such observations that Rafapa & Mahori (2011) appealed for this apartheid ghost to be exorcised warning that the danger of continuing to be spectacular and to boil everything to the effects of apartheid is not imagined but is both real and counterproductive. Failed cycles of reform that emerge when the subject continues to apply a philosophy, an ideology, a method or process even when it becomes inappropriate, inefficient or unsuccessful, have been studied for decades in problem solving situations under the umbrella term of functional fixedness or disruptive fixation. Functional fixedness was first coined by the German psychologist Duncker (1945) to refer to a cognitive bias that acts as a barrier to problem solving. This disruptive fixation impacts individuals, organisations and societies differently but for nations, it has resulted in a lack of innovative solutions to tackle more significant societal problems such as the South African mathematics crisis. With specific reference to the dedicated schools project, disruptive fixation is evidenced by a constant emotional appeal to apartheid that has derailed efforts towards an effective gifted education in mathematical sciences. For example, no learners were selected into the DSP because gifted education implementors got fixated in the long standing elitist view to gifted education; implementors got fixated in the same old view that a one-size-fits-all curriculum was appropriate for all learners hence no differentiated curriculum was designed for the gifted, teachers got fixated in their old teacher centred approaches hence no learner centred approaches were designed, implementors got fixated in their view to a 30% being a pass mark for mathematics hence top-end performance was never planned for adequately. In the case of classroom instruction, one form of disruptive fixation is the way home languages and traditional games have been dragged into the fray and couched as giving learners epistemological access to mathematical knowledge which they get denied when taught in a foreign language. Concerned about such a practice over the years, DBE took a clear position and in a recent [23 May 2024] newspaper article Minister Motshekga announced that, “there will be a phased incremental implementation of Mother Tongue-based Bilingual Education [MTbBE], targeting in Phase 1 Mathematics and Natural Science and Technology in Grade 4, starting in 2025, incrementally going up until the end of primary school in 2028”. In mathematics education, ethnomathematics is the study of the relationship between mathematics and culture where culture and language are inextricably linked. In many African countries ethnomathematics researchers argue for the use of the learners’ home languages on the basis that apartheid leaders fought against the use of African languages as LoLT which was seen as a device to ensure that Africans remain oppressed (Setati, 2008). Similarly, Nkopodi & Mosimege (2009) further argued that the challenge of incorporating IKS into the mathematics and science classroom was due to the reality that both subjects were commonly considered 'Western' and rarely associated with African culture. More recently, Tachie & Galawe (2021) argue that the curriculum is based on foreign ideology, rather than on local ones. They further cite Deresky (2017), who mourned that education in South Africa is based on foreign ethics and values which learners find difficult to understand. However, Aikenhead (2017), warned that some projects risk accusations of tokenism, insensitivity, marginalization, appropriation, or neo-colonization. In such cases, we need to be vigilantly aware of not inadvertently recolonizing the people we intend to serve.

The decision by DBE to roll out mother tongue classes presents researchers with a typical example of an if-then argument to analyse. If–then statements usually propose a special connection between the if-clause and then-clause. Identifying the specific nature of the connection is usually the key to judging the truth or fallacy of such a statement and to successfully defending that judgment. When one judges an if–then statement to be true, a good way to defend one’s judgment is to identify the secondary assumptions that are most likely to be in question, given the circumstances, and to point out their truth. In this case proponents for home language use could be guilty of what is called the fallacy of affirming the consequent and by this we mean from the antecedent that children face problems when taught in a foreign language the consequent (teach them in home languages) might not necessarily follow especially in cultures where this concept is not present. There is also empirical evidence to show that there are eloquent English speakers who struggle with mathematics just as there are brilliant mathematics students who struggle with English and yet there are some who are excellent or dismal at both. All these are secondary assumptions or auxiliary hypotheses that get ignored in the simplistic statements proffered by ethnomathematics researchers. For example, the DoE (2001) also noted that difficulties associated with the learning and teaching of mathematical sciences are also associated with lack of proficiency in the medium of instruction [i.e. English]. Other studies have shown that English first language speakers struggle with mathematics just like any other because mathematics is considered a universal language given that it has vocabulary, grammar, syntax, through which people use and understand it. Meanwhile in the analysis by Gondwe (2022), about half of the black matriculants who achieved an A-aggregate had attended formerly white and Indian schools where they learnt in English. All these are secondary assumptions or auxiliary hypotheses which confirm the view that the movement from an antecedent to a consequent is not always neat hence in the case of mathematics education, the DoE (2001) concluded that language problems reflect insufficient conceptual understanding. Similarly, Vishal & Skovsmose (1997) point out that the ethnomathematics research programme lacks the theoretical resources to distance itself from apartheid education further arguing that reference to political goals cannot be part of the technical core of a scientific research programme. Hence similar South African studies that have emerged from the experiences on Trends in Mathematics & Science Studies [TIMSS] have also recommended that the solution to improving African learners' performance in mathematics is to develop their English language proficiency (Reddy, Winnaar, Juan, Arends, Harvey, Hannan, Namome, Sekhejane & Zulu, 2021).

Contrary to that official policy position, it is in this context that claims are made that in a traditional game known as morabaraba, concepts such as addition, subtraction, quadrilaterals, similarity, functions, ratio and proportion are embedded. Nkopodi & Mosimege (2009) even recommended that the indigenous game of *morabaraba* should be incorporated in the learning of mathematics. Similar claims are made about other indigenous games hence judging by the prevalence of such claims, Pais (2013) fears that in South Africa, a whole knowledge industry is developing around the idea of IKS, of which ethnomathematics is one component. Logic would dictate that if the growth in the knowledge industry was positive then there wouldn't be an expression of fear. However, Pais' expression of fear, which is shared by many other critics, suggests that whoever is obsessed with the notion of ethnomathematics needs to get over their obsession. Similarly, according to Gardner (2023) there is as yet little concrete evidence to suggest that a major shift of emphasis of the kind proposed by advocates of ethnomathematics and its sibling Mathematical Literacy would lead to widespread improvement in the classroom. Schirmer & Visser, (2023) also argued that many reform efforts do not address the challenges at the heart of the country's poor performance partly because they have focussed on the wrong priorities.

AIMS AND OBJECTIVES

The aim of this theory paper is to take a critical analysis of how each of these indigenous games present authentic mathematical learning environments. This is important in more ways than one. Firstly, plausible-sounding reform rhetoric rarely translates into large scale improvement at the chalkface level hence when faced with some new proposal, researchers have no choice but to exercise judgement in order to assess its likely efficacy (Gardner, 2023). It is therefore important to look beneath the plausible-sounding surface to see whether the claims made for ethnomathematics, make sense, to ask whether there is a real danger that the new emphasis on ethnomathematics may become the latest in a series of bandwagons whose negative effects will eventually outweigh any possible benefits. Secondly, while it appears educationally sound that learners will understand things better when taught in their home language, there is also evidence to show that this is not beneficial to learners in cultures where the concepts are absent. Gardner (2023) also pointed to another downside where politicians, teachers and learners naturally seize upon this suggestion that there may be a pragmatic-sounding alternative to “difficult” mathematics. The main danger is the impulse to convert a major part of the curriculum to this form of instruction. For example, Goos & O’Sullivan (2023), show how the new South African Mathematical Literacy [ML] curriculum took inspiration from a mixture of educational positions including socio-constructivism and ethnomathematics. Consistent with this perspective ML curriculum promotes the idea that mathematics is a cultural product involving the use of authentic real-life contexts. The mathematical content of ML is limited to those elementary mathematical concepts and skills that are relevant in the everyday lives of individuals. In general, the focus is not on abstract mathematical concepts and as a rule of thumb, if the required calculations cannot be performed using a basic four-function calculator, then the calculation is in all likelihood not appropriate for ML. Furthermore, since the focus in ML is on making sense of real-life contexts and scenarios, in the ML classroom mathematical content should not be taught in the absence of context. Bureaucrats then imagine that focusing on ML from the outset will deliver what they see as the required end-product [such as the much espoused 21st century skills] more directly and more cheaply; and, sadly, some educationists see this paradigm shift as an opportunity to further undermine the idea of mathematics as the archetypal “objective” discipline. Gardner (2023) warn that the resulting loss of learning of general (abstract) principles may then deprive the learner of the foundation necessary for recognizing how the same mathematics witnessed in one context in fact applies to many others. In South Africa ML is now considered as a watered-down subject for mathematically weak students hence it is viewed as a superficial change which has failed to meet its transformational aims (Sidiropoulos, 2008) marking those learners who opt for the subject as “disposable material” (Skovsmose, 1997). An even more worrisome challenge is the current migration of learners *en mass* from Pure Mathematics to the same ML which makes them disposable despite the subject having been designed with the intention of providing democratic access to mathematics for all. This development runs contra to the needs of the fourth industrial revolution, which requires highly competent graduates in the science, technology, engineering and mathematics areas. Hence the GNU has shifted the attention of the DBE; instead of looking at ways of making the NSMSTE more effective and efficient, the Director of Special projects who is responsible for the Dinaledi Schools project has a new responsibility. His current task, which is a top priority for the Minister of Basic Education, is to manage a project aimed at reintroducing Mathematics to schools that had stopped offering the subject in preference to Mathematical Literacy. This was never the intention at the launch of the NSMSTE way back in 2001.

The view to ethnomathematics continues to survive due to what Sims (2017) called sanctioned counterpractices - practices that overlook, misrepresent, downplay, excuse, and rationalise actions and policies that appear to undermine and contradict a philanthropic intervention's professed ideals. Hence critics argue that notions of transformation, equity and redress have acquired a plethora of meanings, interpretations and implementation styles, which often have become self-destructive and simply immoral (Spaull, 2019). This paper does not in any way suggest that people should forget about the pains brought about by apartheid as it is part of their history, however current views are that emotional appeals against apartheid are worn out and dredging up dinosaurs from that past is not the way to go about it anymore. The recommendation thereof is that history can be used on the contrary to educate people about such events so that people can take appropriate corrective action. Hence there is need to consider the process of exploring the politics of apartheid not as a burden, but as an opportunity to critique and see what one can learn, hence helping to decide what one can retain and what one can do without in the present (Attree, 2005). Against this background it is important to question other researchers' established schemas so as to open way for new experiences. By doing so it is also possible to mitigate the effects of functional fixedness and open the doors to a more flexible and adaptive way of thinking. For example, Gustafsson & Taylor (2013) warn that ideology often clouds reason in education research and policymaking. They cite Psacharopoulos (1996), a key figure in the emergence of economics of education as a discipline, who has argued that in the field of education, perhaps more than in any other sector of the economy, politics are substituted for analyses. In South Africa mathematics is at the core of such debates given that apartheid considered it absurd to teach a Black person mathematics. However, Psacharopoulos (1996) goes further to warn that an antiracist policy that is simply preoccupied with antiracism is always at risk of reproducing, in the structures of its outcomes, the very racist practices it pretends to overcome.

THEORETICAL FRAMING

In recent analyses of real-world problems some researchers have emphasised that to overcome a state of functional fixedness there is need to adjust an incomplete or incorrect initial representation of the problem (Patrick & Ahmed, 2014), while others have recommended that there is need to focus on unnoticed or obscure features present in the initial settings (McCaffrey, 2016). Consistent with this recommendation of focusing on obscure features of the South African mathematics crisis this paper draws the reader's attention back to proponents of indigenous games and language. For example, Tachie & Galawe (2021) argue that indigenous games can be incorporated into the teaching of mathematics for the 21st century – but what does that mean. Until such time we really understand the nature of 21st century skills we run the risk of confusticating even rudimentary arithmetic as skills needed in the knowledge-based economy [KBE]. Indeed, there might be some mathematical concepts in indigenous games, but what level of mathematical capabilities matter in the KBE and to what extent can indigenous games enable learners to access such levels of mathematical knowledge? This question is fundamental to our understanding of the skills needed in the 21st knowledge economy and to how we can develop appropriate intervention strategies. To frame its arguments, the paper borrows from MacGillivray (2000) who in her submission to the Australian science capability review, heavily criticised a pervasive narrow view to equitable educational provision for "ALL students; arguing that inclusive education should cater for the needs of the below average, the average and the above average or most able students (MacGillivray, 2000). In framing her advice as an expert in the field, she identified the following three distinctive levels of mathematical capabilities that serve different but complementary purposes in society: Level 1- the quantitative capabilities of the whole of society or an "at-home-ness" with numbers in the everyday life, Level 2 - the mathematical capabilities in the broad spectrum of areas with specific quantitative links (e.g. Actuarial sciences and accountants); and Level 3 - the high-level capability/expertise of the discipline of mathematical sciences. This categorisation does not in any way suggest that any one of these levels has no place in a modern economy. On the contrary MacGillivray posits that improvements in average performance (level 1) and top end performance (level 3) have separate but complementary effects on economic growth. Level 1 provides a sound foundation or what Fensham (1994) referred to as 'induction into science' while the third level provides what has been described as 'empowerment from science", which has been shown to bring about the largest variance on a country's Gross Domestic Product (GDP) – a universal measure of economic development. Although there is this complementarity of capabilities, Fensham (1994) argued that empowerment from science rather than induction into science was a more important way of thinking about the purpose of school science. Hence in South Africa, as part of its commitment to reversing the legacy of apartheid, the DBE reiterated: "We need to improve results at the top end if South Africa is to have world class scientists, designers, analysts and so on" (DBE, 2015).Yet MacGillivray's concern in Australia (which is also evident in South Africa) was that the country's education was not fostering adequate numbers of students who have level 2 "mathematical capabilities or level 3 capabilities needed by society (MacGillivray, 2000).

Educational Provision on the Bell Curve

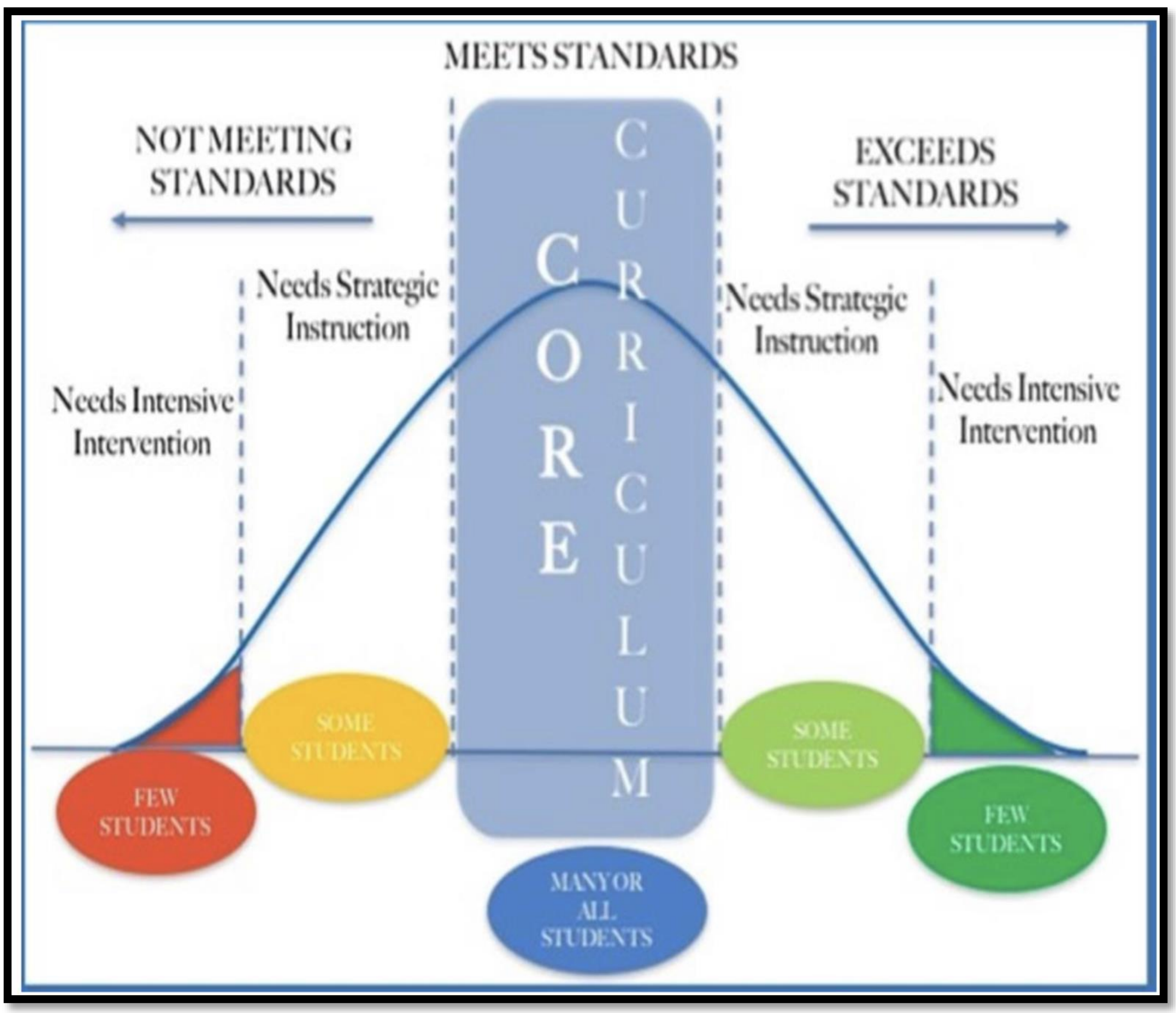

Figure 1: *Educational Provision on the Bell Curve - Source: Griffith* (2012). https://envisiongifted.com/

Although MacGillivray (2000) did not propose such a bell curve, her levels have implications for curriculum design given that her major concern was about an education system which was failing to foster adequate numbers of students with level 2 and 3 capabilities. Griffith (2012) model captures MacGillivray's proposition very well, on the extreme left these as learners that might benefit from level 1 mathematics curriculum, at the centre these are learners who might benefit from level 2 mathematics curriculum and on the right, these are learners who might benefit from level 3 mathematics curriculum. Successful countries such as Singapore adopted such a structure. MacGillivray's major concern was that in countries such as Australia and South Africa in which conventional classrooms do not follow any kind of differentiated program the core curriculum is designed for the average student, teaching is paced for the average student, assessment tools are designed for the average student and evaluation is against the norm, not criterion. Yet efforts that target the average can only assure society of at best the first two lower levels of mathematical capability in MacGillivray's frame. Smith (2006) warned that gifted students who have the potential to provide Level 3 capabilities are not taught at a level commensurate with their intellectual needs when following a core curriculum. Similarly, Papadopoulos (2016), cautioned that the enrolment of gifted children in conventional classrooms that do not follow any kind of differentiated program in terms of content and the learning process, pose risk factors for the development of their talents and the experience of positive emotions. The result of such practices according to Van Tassel-Baska (1989) is that many of these exceptional children under-function as teachers' expectations are set too low and the curriculum provision is intellectually inadequate.

Research Questions

Let me start by pointing out to the reader that the *morabaraba* game is just one variant of *tsoro* games as they are known in other countries, hence I will use the more encompassing term *tsoro* as well. It is also important to note that in South Africa a longitudinal study by Roux (2006) concluded that (a) while there are many other traditional games *morabaraba or umlabalaba* was suitable for educational purposes while others were not (b) morabaraba was most popular among those games suitable for educational purposes (c) 75% of morabaraba players were rural learners and adults (d) the majority of the learners from the urban schools do not participate in indigenous games (some calling them baboon games) (e) the majority of teachers did not teach learners using indigenous games. Given this background this paper is guided by the following questions.

1. What mathematical concepts are embedded in tsoro games?
2. To what extent do the concepts help learners access the level 3 mathematical capabilities?

Tsoro Games

In order for the reader to make sense of the ensuing arguments, it is important to start with a brief description of the *tsoro* games. *Tsoro* is an African indigenous word which means brain war between two parties hence the game is played between two players or two groups of players one fighting a brain war against the other. It also refers to a trick used by one party to win over the other party. The game has several versions varying from region to region, but all are known by the same name, 'tsoro'. Traditionally tsoro is played on any surface where the players can draw and as can be seen in the figures 2 -5 this can be on a rock surface, on hard ground, in soft ground and card/wooden/plastic/synthetic boards. Measurement and straightness of lines if ever done, was done through the bark of a shrub called 'bokwetse', estimation and comparison of lengths of lines was done using non-standard measures such as the middle finger and thumb (span). Traditionally 'tsoro' is played with very simple objects or tokens (called cows in the game), such as hard amarula nuts, wild loquats seeds, gourd shells, corn cobs, stones on the ground surface or in holes on the ground or beans on a cut wooden plate. Nowadays objects such as bottle tops are used to play some of the versions of 'tsoro' but the tokens must be of different colour or shape or texture. When three tokens (cows) with the same colour form a straight line, the player to whom those tokens belong is eligible to take one token (cow) from his opponent. All the tokens from player 'A' are laid out on the board one at a time, while the opponent (player B) will try to prevent player 'A' to get three cows in a row. They are thus arranged strategically all over the board. The aim is then to get them three in a line, called *isibhamu*, (translation is 'gun') as quickly as possible. Once they are all placed, the cows move *(ayahamba)* on the lines and to take as many cows from the opponent as possible. If there are three cows left for each member (a draw), the cows are allowed to 'jump' to reach *isibhamu*, hence the winner. The shooting goes on until the looser remains with less than 3 objects. Below I present figures 2-4 which capture tsoro yemugumi nembiri (gumi means 10 and mbiri means 2 – so the game is played with 12 objects or cows) and this is the *morabaraba*.

Figure 2: Tsoro yemugumi nembiri (tsoro played with 12 objects) version 1

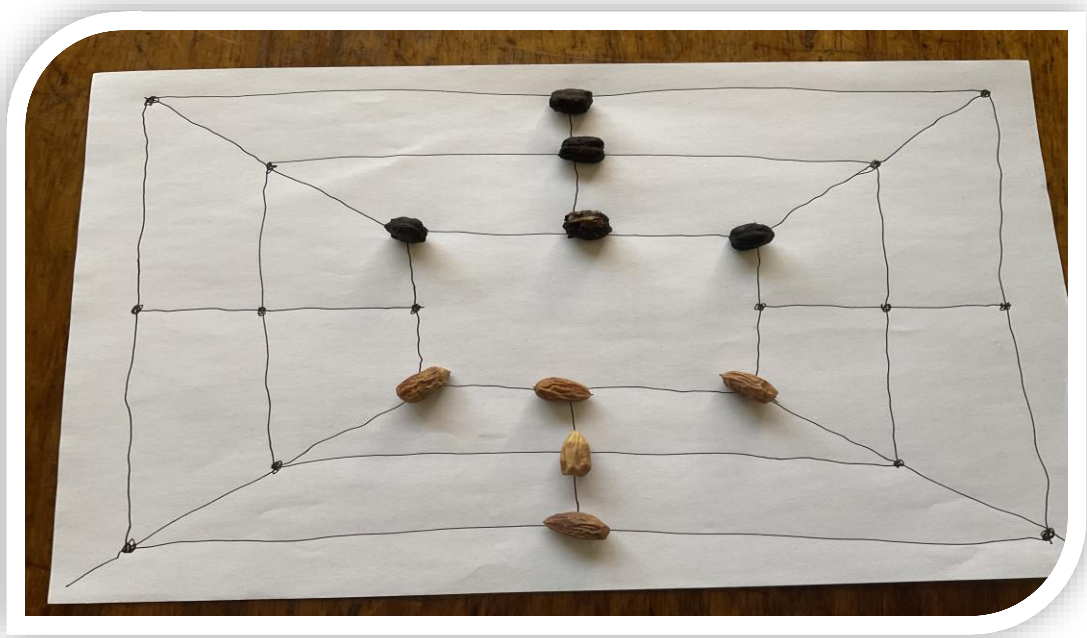

Figure 3: Tsoro yemugumi nembiri (tsoro played with 12 objects) version 2

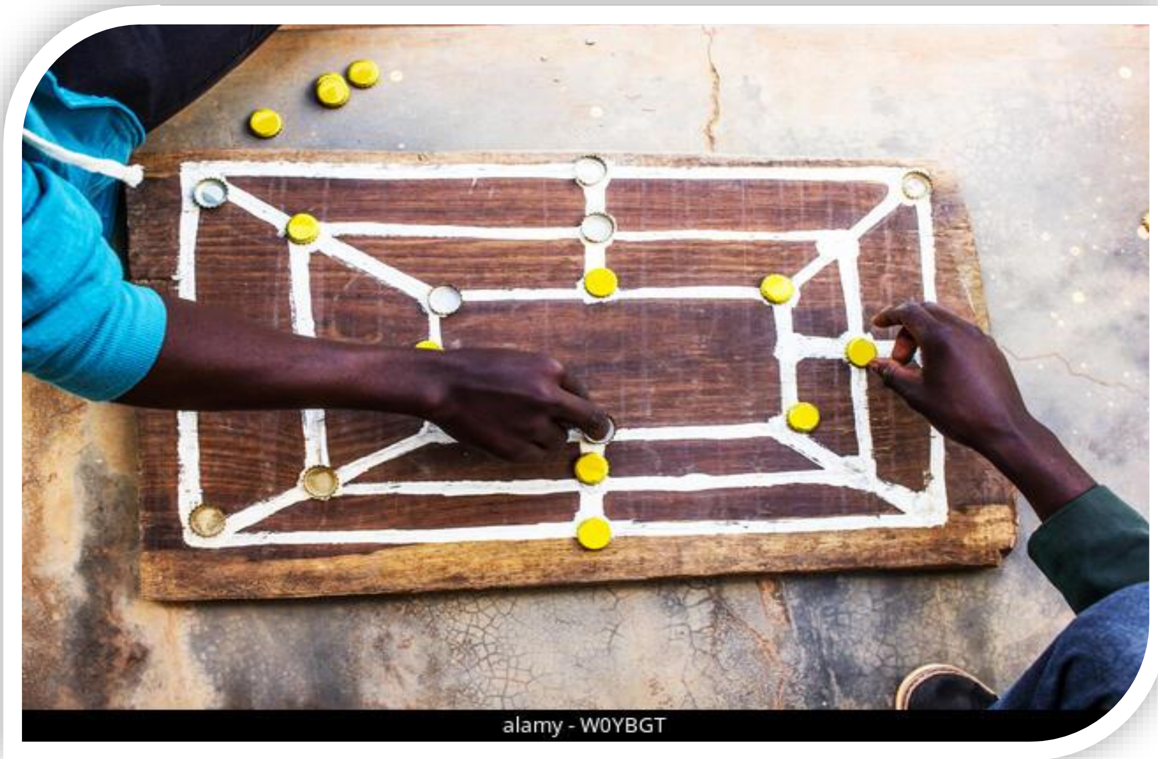

Figure 4: Tsoro yemugumi nembiri (tsoro played with 12 objects) version 3

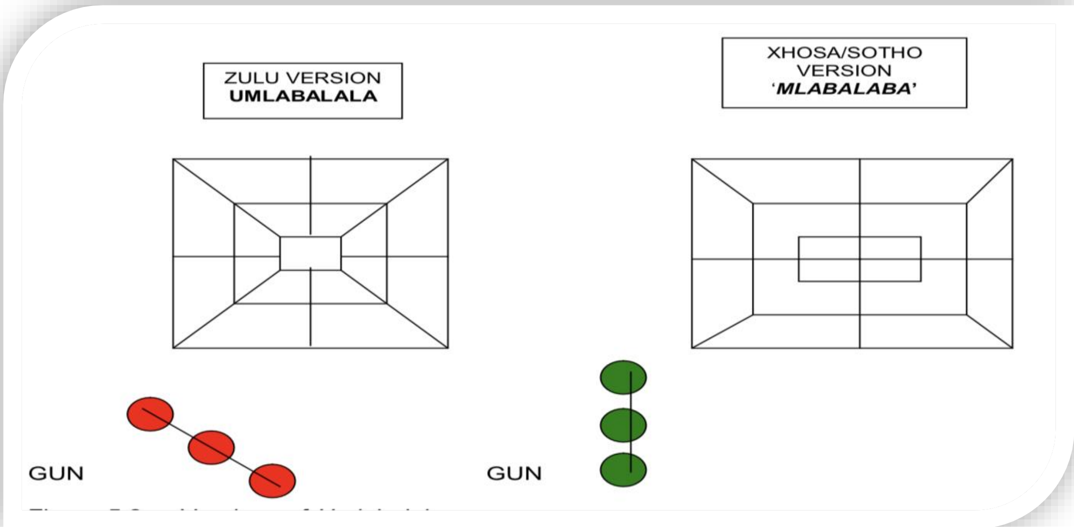

Figure 5: Tsoro yemugumi nembiri (tsoro played with 12 objects) version 4

DISCUSSION

In the first research question the reader is interested to know if there are mathematical concepts embedded in the tsoro games. In order to respond to that question, the analysis will focus on (a) the equipment (b) the experiments that arrived at the concepts (c) whose voice is prioritised.

The equipment

Looking at the *tsoro/morabaraba boards* depicted in Figures 2 -5, let me reiterate that traditionally tsoro is played on any surface where the players can draw, and a major characteristic of the drawing is that it is done free hand. However, Figure 5 shows what gets popularised by ethnomathematicians trying to justify their claim of the presents of mathematics in the game. For example, Mosimege (2006) states that even though the game is played on specially produced board, boards drawn in the sand are also used for game play. In this case boards drawn elsewhere are trivialised yet the majority of people both young and old don't even play on specially produced boards. Even on the internet what is posted is that *morabaraba* is played on a board consisting of 3 nested squares with points at the corners and in the middle of each side of the squares. Each player selects 12 beads of the colour of their choice. These beads are placed on rows which can be vertical, horizontal, or diagonal. Before the readers realise it, they are patronised into believing there is indeed some mathematics in the *morabaraba* game. However, if we go back to figures 2-4, nothing could be further from the truth because the squares, vertical lines and other mathematical concepts are nonexistent in the traditional *tsoro* games. Without delving deeper into the mathematical semantics, the history of measures tells us that non-standard measures such as span, forearm, hand, or finger were used in different cultures. Since then, standardised measurement has never been incorporated in all traditional or indigenous games which are always drawn free hand back in the village. Let us recall that, an argument [especially in mathematical logic] is valid if and only if in every case where all the premises [antecedents] are true, the [consequent] conclusion is true. Otherwise, the argument is invalid. From how I have presented the boards for *morabaraba,* the reader should be able to notice that specially produced boards are an exception to the norm when it comes to indigenous games. Specially produced boards, as the name implies, are designed borrowing from 'Western' mathematical concepts of straight lines and angles to improve the aesthetic value of traditional games. Hence Dowling (1998:14) lamented that research in ethnomathematics "succeeds in celebrating ethnic cultural practices only by describing them in European mathematical terms, that is, by depriving the indigenous games of their social and cultural specificity". Similarly, Larvor & François (2018) argue that ethnomathematicians impose the concept of mathematics on practices found in cultures where this concept is not present—specifically, a concept of mathematics that is abstract and modern. They do so by borrowing from the same 'Western' register they demonise hence Larvor & François (2018) argue that there is inherent transgression.

Experiments that arrived at the conclusions

WORKSHEET 1

1. Name all the shapes or figures shown in *morabaraba* game.
2. To justify the answer in question 1 measure (in cm) the dimensions of the above shapes and compare your response with question 1.
3. How do the shapes or figures in question 2 relate?
4. Calculate the area covered by the shapes or figures and the perimeter of the shapes.
5. What deductions can you make from question 4?

Worksheet 1 provides the questions that were used in one of the studies which arrived at the conclusion that some geometrical shapes were embedded in the *morabaraba* game. One could then ask: Do players of indigenous tsoro games draw straight lines, do they use *cms* to measure their lines, do they use a ruler anywhere in their game, do they have instruments for measuring right angles or any other angles, do they have the concept or units of measure for area in their game, where in the game do they apply ratio and proportions? Clearly these are questions based on a specially designed *tsoro* board because none of these questions would be intelligible in the case of a traditional board drawn free hand on the ground or any other surface. The papers that were analysed for this paper all reflected this same specially designed board. The question one could then ask is: What do the players in the rural areas who draw their boards free hand in the ground see in their game? Are they not likely to make the same but erroneous conclusion that there are squares, rectangles and the rest of the mathematical concepts in their game of *tsoro* without considering the specific properties of each of these geometric shapes? As long as such generalisation cannot be made for all *morabaraba* games, Larvor & François (2018) argued that this is unlikely to help learners hence they concluded that some of the obstacles to learning mathematics are cultural. Their suggestion was that pupils might do better starting school mathematics from a blank slate after all.

Whose voice is prioritised

One of the meanings of culture can be depicted by how the members of a cultural group make sense of experience through their language, symbols, values, norms, social practices, and use of material artefacts (Banks, 2016). The premise justifying ethnomathematics research goes as follows: it is assumed in theory that learners already have some kind of ethnomathematical knowledge before they come to school, and this knowledge should be a resource and therefore the basis for the learning of scholarized mathematics (Abreu, Bishop & Presmeg, 2002; Borba, 1997). The view that learners already have some kind of pre-school proto-mathematical knowledge which should be considered by the teacher when organizing the learning of the school mathematics assures that cultural differences are valorised, and a better learning can occur (since students are not starting from scratch but from their own life experiences). However, in practice cultural difference are not valorised because ethnomathematics shifts mathematics from the places where it has been erected and glorified (university and schools) and spreads it to the world of people, in their diverse cultures and everyday activities. Pais (2013) exemplifies this process well. He says usually, a typical ethnomathematical researcher will go to a local community (whether it is an indigenous, ethnic or professional one), observe people performing their daily practices, and try to identify mathematical motives in what they are doing. She can, for instance, spend time observing indigenous people constructing a house, talk with them, make questions, and, sooner or later, the mathematically trained observer will start to see mathematical content in the communitarian task of constructing a house. Let us say that she clearly identifies what these people are using to construct their houses as being Pythagoras' theorem- despite the fact that these people have never before heard about such a thing. The researcher can, then, produce an entire catalogue of the mathematics behind the construction of a house, and write an academic article to be published in an international journal, showing how it is not just the Europeans who know mathematics. She can also use this knowledge for educational purposes, as is the case with the majority of ethnomathematics research, as a way to teach more formal mathematics to these people. In the case of South Africa, Figures 6 and 7 illustrate this point.

Figure 6: Tsoro yemakomba (tsoro played with pebbles in holes

k	i	j	Remarks
6	$(2,6) = 2_1$	$(1,6) = 11_2$	unique
1	$(2,1) = 9_2$	$(1,1) = 3_1$	$tie,\ k = 1, 7$
7	$(2,7) = 4_1$	$(1,7) = 10_2$	unique
2	$(1,2) = 6_2$	$(2,2) = 1_1$	unique
5	$(1,5) = 7_1$	$(2,5) = 10_2$	unique
8	$(2,8) = 3_2$	$(1,8) = 1_1$	$tie,\ k = 3, 8$
3	$(1,3) = 2_1$	$(2,3) = 4_2$	unique
4	$(1,4) = 4_2$	$(2,4) = 3_1$	unique
Total	37	43	

Figure 7: Solution indicating game in favour of player *i* (Source: Kumar, Ncube & Munapo, 2003)

For example, in another ethnomathematics study focusing on tsoro yemakomba, Kumar, Ncube & Munapo, (2003) observed tsoro yemakomba players, deciphered some mathematical formula for winning this game [see figure 7]. The analysis of how *tsoro yemakomba* is played which was also done by Masiiwa (2001) is said to have brought out some high-powered mathematical concepts. In another example, researchers showed how the first player can start from a certain hole and win the game before the second player even plays -something similar to knocking out the opponent with the first blow. In the *tsoro yemakomba* game, that knock-out blow before another player even starts is called *chihwangu.* While the players discover *chihwangu* through constant practice, they don't have the mathematical vocabulary to describe that winning formula. However, Masiiwa (2001) discovered that *chihwangu* occurs for: 2^n holes per row and 2n -1 pebbles in each hole. The question is: who is discovering this algebra, is it the player or the researcher and herein lies the problem of transference in ethnomathematics. Research on ethnomathematics has been analysed from various perspectives one of which is its inherent transgression. In this regard the potentially emancipatory enterprise such as ethnomathematics is usually transformed into what Žižek (2008, p. 76) calls an "inherent transgression". This is a change that is already predicted and even promoted by the same system it tries to change. It allows people to ease their consciousness, while at the same time assures that no fundamental change in schools or in the economical organization of society occurs. Change does not occur in the classrooms because activities from indigenous games and languages are not seen as mathematics by the players. On the contrary such activities count as mathematics because modern mathematicians can recognise abstract structures in them, but this is unlikely to help learners who don't even have a clue of what's going on. Just like in many other ethnomathematics research, when learners play tsoro yemakomba none of them considered themselves to be engaged in doing mathematics such as probability or algebra. Hence, according to Pais (2013) we can thus raise the question of how we can say what certain people are doing is mathematics, if they do not recognize it as mathematics. Larvor & François (2018) concluded that ethnomathematics analyses 'ethnic' practices using a concept imposed from without, a concept, moreover, which is only intelligible to the relatively small number of people with a university-level education in contemporary pure mathematics. In such cases, people that have never before been heard in mathematics such as *tsoro yemakomba* players are told that what they were doing all their lives when playing their traditional games was mathematics. Such recognition, so goes the mantra of ethnomathematics, allows them to become emancipated, even to feel proud for being good at something as inaccessible as mathematics (Pais, 2013). However, critics argue that people have a voice as long as their voice is the voice of the oppressed, the voice asking for help, the voice we expect to hear. Yet in ethnomathematics research it is as if there was an underlying desire to keep some one in the status of a victim, so that researchers can enact in themselves the desire for helping. As posed by Žižek (2008), "the saintly person uses the suffering of others to bring about his own narcissistic satisfaction in helping those in distress" (p. 101). Yet this "saintly" spirit, similar to the one of charity and philanthropy, completely endorses the spirit of capitalism that it purports to dismantle. It allows people to ease their consciousness, while at the same time assures that no fundamental change in schools or in the economical organization of society occurs – hence disruptive fixation.

Levels of mathematical capabilities promoted in morabaraba

In the second research question, the intention was to analyse the level of mathematical concepts (if any) which are embedded in the tsoro games. Proponents for indigenous games and language claim that these games can give learners epistemological access to mathematical knowledge required for developing 21st century skills. Admittedly there are various arguments for what constitutes ideal mathematics for the KBE. However, Bialik & Kabbach (2014) provided some ideas which might address the fundamental question of "WHAT should students learn for the 21st century?" The authors show how the Center for Curriculum Redesign [CCR] brought together non-governmental organizations, jurisdictions, academic institutions, corporations, and non-profit organizations including foundations to contribute to this debate. In that article authors argue for an integration of real life and abstract concepts, one that by combining pure and applied mathematical topics will best engage and best prepare all our students for 21st century life. Within that combination there will be a balance between pure mathematics (algebra, analysis, geometry) and applied mathematics (statistics and probability, numerical mathematics, plasma astrophysics). Table 1 is a summary of the articles that were analysed for this question with those recommendations in mind.

Paper code	Approach	Topics	Listed	Explained
MI	Observation and interviews	• Quadrilaterals • Ratio and proportion • Symmetry • Counting	X	
CN	Literature review	• Sets • Division • Counting	X	
G	Observation and interview	• area, • ratio and proportions, • geometric figures, • numerical patterns	X	
TM	Observation in grade 10	• algebraic expressions, • equations, • number patterns • geometric figures	X	
SM	Observation and interview Form 3 class	• Probability	X	
M	Observations and interviews	• algebraic expressions, • equations, • number patterns • geometry • analytical geometry	X	
NF	Observation	• Logic • Probability • Prediction	X	
CR	observations and interviews	• Psychomotor • Cognitive • Affective • Social		X

Table 1: Summary of articles that were analysed for this question

Notwithstanding the evidence that mathematics is dragged into indigenous games by ethnomathematics researchers I still wanted to analyse the nature of the concepts they claim are embedded. In the table one could notice that a paper coded CR identified educational but not mathematical outcomes from indigenous games. The rest of papers which identified mathematical concepts were purely by listing. A strong argument for embedded mathematical concepts would be supported by extensive explanation of how for example probability is utilised by tsoro players. This is a yawning gap in all the studies that make such claims. In terms of diversity of topics, one might be able to notice that the topics identified by researchers in Table 1 are so few when compared to those covered in the school curriculum. Pais (2018) also observed that research in ethnomathematics in the last fifteen years, has become predominantly focused on "local cultures" and non-scholarized forms of mathematical knowledge. Yet according to Larvor & François (2018), one way of using ethnomathematics in the classroom is to offer pupils activities that can function as a bridge from the mathematical practices they already engage in, to the school mathematics curriculum and thence to practical mathematics for their future lives. This may only be plausible if the pupils' mathematical practices are relatively close to the curriculum—for example, if they are already using rulers, protractors, algebra, analysis, geometry as well as standardised measures of weights and lengths. Similarly, according to Roux (2006), indigenous games, for example, the use of the Zulu kraal, as well as the cattle kraal, supports the teaching and learning of mathematics when they are designed with mathematical precision and where concepts such as parabola is incorporated into teaching and learning in schools. If this connection is weak or absent according to Skovsmose (1997), this does not benefit the students at all. Beyond connection with the local school curriculum, Pais (2013) also warns that although we live in a world of multiple social, cultural and political realities, we must ask what, in all these different sets, remains unchangeable. In this context, once we talk about the role of schools in responding to an economic change such as the fourth Industrial Revolution [4IR], the political role that is suggested in ethnomathematics leads to "superficial changes" (Freire, 1998, p. 508). This is so because the Real of School remains unchangeable irrespective of the didactical, curricular and even cultural innovations perpetrated both by researchers, politicians and practitioners.

In terms of integration of real-life and abstract mathematical concepts it can be argued that all the concepts that are listed in Table 1, regardless of who recognised them, were drawn from real-life context of *tsoro* games. Therefore, they all lack in terms of abstraction yet mastery of basic numeracy and measurement, which has long constituted the rudiments of mathematical knowledge required for participation in society, no longer suffices today (UNESCO, 2012). In Bialik & Kabbach's (2014) frame pure and applied mathematics are inseparable Siamese twins suggesting that it is simply not an either/or situation. In the case of South Africa, Larvor & François (2018) argue that the proposal that pupils from different ethno-cultural backgrounds should have different kinds of mathematical education to valorise their cultural differences sounds rather like the same rationale that used to be given for the educational arrangements under apartheid. They further argue that promoting cultural differences has implicit racism hence by so doing we would be unconsciously promoting the same system we are trying to change. In fact, when the South African mathematician of note Prof Loyiso Nongxa, was still vice president of the International Mathematical Union [IMU], which promotes international cooperation among mathematicians, he is among those who were concerned that the decolonization movement could disadvantage young South African mathematicians on the international stage if curricula were changed or alternative methodologies take hold. Distancing himself from the heated debates about indigenous games and languages, which risk the domestication of the other, he said that South Africans can't cut themselves [off] from mathematical developments in the rest of the world, and if that happened then the country's intellectual project would be impoverished. In fact, based on his strong belief that ethnomathematical researchers were barking up the wrong tree, he founded the Talent Targeting Project [TTP] at the University of the Witwatersrand on which gifted learners from previously disadvantaged communities were identified and taught successfully in English and had a sterling 94% success rate sustained over a 17-year period [SETMU, 2022]. Other researchers warn that modern conventions of mainstream mathematics have become 'privileged' (i.e. accepted by the world's mathematical community and numerous secular societies) for reasons that have little if anything to do with the politics of nations or ethnic groups but have much to do with their pragmatic value (Rowlands & Carson, 2004, p. 339). What these authors criticize is the idea that school learning should be centred in the development of local and practical knowledge of the students. According to them, such a utilitarian education will limit students' life chances. In this sense, the introduction of ethnomathematical ideas in school can function as a factor for exclusion, because students from other cultures will only learn a local and rudimentary knowledge that scarcely contributes to their emancipation while the students from the "dominant culture" continue to learn the academic mathematics that allows them to compete in a more and more mathematized world,

CONCLUSION

This paper was triggered by counter claims where on one hand at the launch of the NSMSTE the department of education was clear that learners with mathematical potential would be identified and nurtured in Dinaledi Schools where they would be taught in English. On the other hand, ethnomathematics say nae, learners must be taught in their mother tongue using indigenous games. They further propose that *morabaraba* games should be included in the school curriculum because within it there are embedded mathematical concepts which can benefit learners from diverse cultural backgrounds. I then analysed these claims through concepts identified in papers written on the subject by South

African ethnomathematics researchers. However, the analysis shows that indigenous games have very limited mathematical concepts embedded therein, while the more nuanced forms of mathematics are dragged into the indigenous games by ethnomathematics researchers who have an axe to grind with apartheid. The effect of presenting a localised, emancipating, apartheid free, ethnomathematics was that a user-friendly but watered-down ML curriculum was developed as an option, and students migrated en mass to ML. This is counterproductive to the country's efforts towards gifted education and the developing skills for the 21st century. Going forward it is important for those in the wider mathematical community to examine critically the claims underlying this global trend of ethnomathematics to avoid the disappointment of yet another "false dawn".

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