# The use of contextualised teaching and learning in grade 11 and 12 mathematics classrooms in Gobabis, Namibia

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**Abstract**
This paper investigates the use of contexts in the teaching and learning of mathematics in two secondary schools in the Gobabis area using the Mayoh & Knutton (1997) taxonomy. It was found that not all contexts as suggested by Mayoh & Knutton were used by the teachers and that the context were almost entirely initiated by the mathematics teachers and were used as a primary strategy for presenting the content. The study recommended the introduction of the use of contexts in the pre-service training of mathematics teachers and that teachers create their own mathematics problems to solve rather than adhering to the problems provided in their textbooks which are often of a foreign origin.

## Introduction

For many students, school mathematics seems completely separated from what they do at home and in the community. They cannot see the point of what they are doing in mathematics in school. They also cannot see the connection between the mathematics they do at school and the mathematics that they do in other places such as the market, kitchen, or in the fields (Portman & Richardson, 1997; #Hara-Gaes, 2005).

It is further, widely believed that mathematics is an abstract subject that is important and yet with no relevance to daily activities. However, Frobisher & Orton (1996) view mathematics as a powerful tool with great relevance to the real world. Further, they suggest that for this to be appreciated by the learners they must have direct experiences of using mathematics in a wide range of contexts throughout the curriculum.

Some teachers do little proper preparations and do not use the learners' experiences as the starting point of their teaching, which worsens the above situation. Teachers who also tend to use abstract examples when going about the business of teaching mathematics do not help the learners to see the connection of school mathematics to their everyday lives (Makari, Gervasius & Kasanda, 2006).

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Mathematics teachers should make contextual teaching and learning (CTL) a part of their instruction. That is, connecting educational theoretical knowledge to community practical applications (relating classroom content to the 'real' world). In doing this the teachers will succeed in: breaking the barriers between home and school learning experiences;

making the link between the mathematics that is used in the community and the school syllabus obvious and above all, making school mathematics more relevant, meaningful and enjoyable to learners.

## Theoretical Framework

CTL is a new instructional approach rapidly being adopted by teachers, particularly math and science teachers, across many nations (Glynn & Scott, 2003). However, for CTL to be considered a legitimate pedagogy to be applied with learners, it must be based on sound educational principles, theories and practices. CTL builds upon bodies of literature that include theories and writings by Dewey, Piaget, Bruner, Vygotsky (quoted by Fosnot, 1996) and others. Thus, it is an extension of past thinking, theories, testing and writings.

Moreover, CTL integrates the philosophies of social constructivism and brain-based learning in a theory of learning that utilises a student's experiences and interests to make connections between academic concepts and real-world applications (Johnson, 2002; Glynn & Scott, 2003; Pate, 2003).

## Statement of the Problem

Many researchers such as Dlamini (2007), Cain (2002), Kasanda (2001), Mwakapenda (2001), Campbell & Lubben (2000) are of the opinion that the use of CTL in teaching mathematics has the potential to change various aspects of student learning such as interest in mathematics, critical reflection and active participation.

The purpose of this study was to investigate the extent to which contextual teaching and learning was applied in grade 11 and 12 mathematics classrooms in secondary schools and what type of everyday contexts are used in the NSSC mathematics classrooms in secondary schools in Gobabis?.

## Questions of the Study

The main research questions were:

1. To what extent is contextual teaching and learning applied in grade 11 and 12 mathematics classrooms in secondary schools in Gobabis?
2. What types of everyday contexts are used in the NSSC mathematics classrooms in secondary schools in Gobabis?

## Review of Related Literature

Contextual teaching and learning represents a concept that involves connecting the content that students are learning with the context in which that content could be used. Connecting content with context is an important part of bringing meaning to the learning process (Kasanda et al., 2005; Johnson, 2002).

Contextual teaching can be viewed as a way of answering the famous question that most learners ask, i.e. Why do we have to know this? That is because contextual teaching helps the learners to become active learners as opposed to being passive. Thus, the learning process will be more meaningful to the learners and will help show them how the information fits into the community outside the classroom and how members of the community use the

knowledge in their everyday lives. A teacher who uses the contextualised method will not lecture to the students but rather he/she will act as a facilitator of student learning.

In a study on the role of everyday contexts in learner-centred teaching Kasanda et al. (2005) argued for the inclusion of everyday contexts in mathematics and science education in two partly overlapping perspectives; that is, their effectiveness for achieving particular learning outcomes and their desirability for an appropriate curriculum. On the use of everyday contexts for improving learning, they noted that research into the learning effect of the use of everyday contexts infused in science and mathematics was limited and inconclusive.

In a study of responses of Swazi students to contextual learning, Lubben, Campbell & Dlamini (1996) cited in Campbell & Lubben (2000) identified three types of contexts, which increase learners' motivation, interest in science learning and their participation in classroom activities. They found that positive attitudes were displayed towards lessons, which allowed the learners (i) to work on personally useful application of science, (ii) to own the lesson activities by contributing their expertise and knowledge, and (iii) to discuss contentious issues.

The most frequent argument for CTL, however, has been that it provides relevance to the learning of school science (and mathematics) (Campbell & Lubben, 2000). Mayoh & Knutton (1997) suggest that within the issue of relevance two questions need to be specified: '*relevant to whom?*' and '*relevant to what?*'. This research explored the relevance of CTL of mathematics to the learner. In terms of '*relevance to what?*', this research focused on the relevance to everyday life, further education as well as the world of work.

As Julie (2006) observed, teachers' beliefs, views and preferred contexts for mathematical literacy is at most an under-researched area. It therefore came as no surprise to the researchers that research into these areas is limited and inconclusive. The researcher therefore reviewed related literature that did not address the issue (mathematics teaching and learning) directly.

Mutemeri & Mugweni (2005) found that children's out-of-school strategies of solving mathematical problems and even their out-of-school experiences did not form part of the teachers' business in helping children learn mathematics. Lack of using what learners know in the teaching of mathematics is probably one of the reasons why the learners find the learning of mathematics difficult, lose confidence in problem solving and in some cases develop negative attitudes towards mathematics. Thus, mathematics learning should start with what the learners experience in everyday life.

## Methodology

### Research Design

This study was a qualitative, exploratory and descriptive in nature and was aimed at determining the extent to which CTL was practiced in secondary schools in Gobabis. The study was also exploratory in that it attempted to generate ideas that the teachers had about CTL and it was descriptive as it attempted to describe the practices of CTL in mathematics classrooms in Gobabis (Johnson & Christensen, 2004).

However, quantitative data in the form of frequency tables was also used in summarising

and presenting the data. This research design was used because it has the potential of providing the researcher with a lot of information (Fraenkel & Wallen, 1993), thus leading to a better understanding of the mathematics teaching and learning practices in secondary schools and the types of everyday contexts used in the Grade 11 and 12 mathematics classrooms in secondary schools in Gobabis.

### The Sample

The sample comprised two mathematics teachers purposefully selected. These teachers were teaching mathematics at the grade 11 and 12 levels in the two secondary schools in Gobabis.

### Research Instruments

Two types of research instruments were used to collect data from the sample. This allowed the researchers to have a deep understanding of the use of CTL in the mathematics classrooms in Gobabis. The instruments comprised the interview schedule. These were face-to-face and contained semi-structured open-ended questions. The Non-participant naturalistic observation formats (Fraenkel & Wallen, 1993) were employed in this study.

### Data Collection Procedure

Permission to conduct the main research was obtained. Twenty-five lessons of NSSC mathematics were observed at the two schools. The lessons were also tape recorded to help in the identification of contexts used and the pedagogical strategies for the use of the contexts.

Teacher interviews were conducted after the completion of the observation process. This was deemed fit because if the interviews were conducted earlier the teachers might have structured their lessons to impress the researcher, as they would have found out the 'real' purpose of the study.

### Data Analysis

The data, including worksheets (given to the learners during the observed lessons), classroom observation records and the interview transcripts, were scrutinised to identify the extent to which mathematics content was contextualised as well as the type of contexts used.

## Results

### The Use of Contexts in Mathematics Lessons

Table 1 presents the number of times that the two mathematics teachers and their learners referred to everyday contexts during their lessons. The table indicates that on average 1.8 classroom episodes per lesson related to everyday contexts. Teacher A however had a higher average of 2 episodes per lesson compared to the average of Teacher B of 1.7 episodes per lesson relating to everyday contexts. The table shows that Teacher A had initiated 6 more contexts than Teacher B, the observed difference was however not statistically significant. This is supported by the calculated Chi-square ($X^2$) value of 0.39 being less than the 3.84 value obtained from the table of critical values for $X^2$ at 0.05 level of significance for one degree of freedom.

Table 1 also shows that the learners at both schools did not initiate any episode referring to everyday contexts the teachers initiated all contexts. Contexts in the textbook examples

and activities that were referred to during the observed lessons were classified as everyday contexts initiated by the teachers.

**Table 1. Frequency of teachers' and learners' references to everyday contexts (N=46)**

| Frequency of using everyday context | | | | | |
|---|---|---|---|---|---|
| **Teacher** | **Number of lessons observed** | **Teacher initiated** | **Learner initiated** | **Total** | **Average per lesson** |
| Teacher A | 13 | 26 | 0 | 26 | 2 |
| Teacher B | 12 | 20 | 0 | 20 | 1.7 |
| **Total** | 25 | 46 | 0 | 46 | 1.8 |

## The Types of Everyday Contexts Used

The taxonomy suggested by Mayoh & Knutton (1997) was used to identify the types of contexts used in the mathematics classrooms. Mayoh & Knutton distinguished 12 categories of contextualised lesson episodes as presented in the first column of Table 2. The remaining columns of table 2 show the frequencies (percentages) in which the various types of everyday contexts used by the two mathematics teachers.

From table 2 it can be observed that none of the contextualised episodes referred to the media and the industry. Further, none of the episodes attempted to develop the skills of the learners for use in everyday life and furthermore, no episode used everyday context for classroom activities.

**Table 2. Frequencies of the episodes for different types of everyday contexts (N= 46)**

| **Type of every day context used** | **Teacher A (n=26) (%)** | **Teacher B (n=20) (%)** | **Total frequency of episodes (n=46) (%)** |
|---|---|---|---|
| 1. Referring to the mass media. | 0 (0) | 0 (0) | 0 (0) |
| 2. Referring to personal experience: telling stories. | 2 (8) | 0 (0) | 2 (4) |
| 3. Referring to common out-of-school experiences. | 1 (4) | 4 (20) | 5 (11) |
| 4. Referring to uncommon out-of-school experiences. | 2 (8) | 3 (15) | 5 (11) |
| 5. Referring to common objects. | 2 (8) | 2 (10) | 4 (9) |
| 6. Referring to images from out-of-school experiences. | 1 (4) | 0 (0) | 1 (2) |
| 7. Referring to everyday knowledge. | 3 (12) | 1 (5) | 4 (9) |
| 8. Referring to everyday words. | 8 (31) | 6 (30) | 14 (30) |
| 9. Using analogies and metaphors based on everyday experiences. | 7 (27) | 4 (20) | 11 (24) |
| 10. Using everyday contexts for classroom activities. | 0 (0) | 0 (0) | 0 (0) |
| 11. Developing skills for use in everyday life. | 0 (0) | 0 (0) | 0 (0) |
| 12. Referring to industry. | 0 (0) | 0 (0) | 0 (0) |

Table 2 shows that episodes referring to everyday words had the highest frequency of 14 (30%) followed by the use of analogies and metaphors based of everyday experiences with a frequency of 11 (24%). The contexts referring to common out-of-school experience as well as the uncommon out-of-school experience had the same frequency of 5 (11%). However, Teacher A used a wider range of contexts (classified into 8 categories) as compared to Teacher B (classified into 6 categories). As further illustrations of the types of contexts used, examples of episodes are now provided:

**Episodes Referring to Everyday Words**

The use of everyday words was noted as the episodes with the highest frequency of use (30%). An example of an episode referring to everyday words was observed in a lesson on simultaneous equations presented by Teacher B.

Teacher B: Okay, what does the word simultaneous mean to you?
Learners: Same time [chorusing].
Teacher B: What we have done up to now is to solve an equation like this example (simple linear equation, which the teacher solved on the board):
$2x + 4 = 18$
$2x = 14$
$x = 7$
Remember when we are going to solve simultaneous equations you are still going to solve equations in the same way that you have done up to now.

Later in the same lesson the teacher started to teach the methods of solving simultaneous equations, using the substitution method. Then an element of 'code switching' (i.e. the temporal use of a local language to explain concepts that learners are struggling to grasp in the official language) came into play, which again was viewed as an episode referring to everyday words.

Teacher B: So, I substitute in Afrikaans '*vervang beteken daar is nie weer 'n p nie, daar is eits in sy plek*'. If you substitute then there is no *p* there is something in its place, you are going to replace it.

Further use of episodes referring to every day words came from a lesson on indices were Teacher A pointed to the fact that writing numbers in standard form was the same as writing numbers in scientific notation as used in physical science.

Teacher A: So, those people that are doing physical science …
Learners: All of us [chorusing]
Teacher A: Sometimes if you are talking about huge distances, for example, the distance from the earth to the moon, it is a very long distance so it will be a lot numbers. So to write that in an easy and convenient way we write the numbers in…
Learners: Standard form [chorusing].
Teacher A: When it comes to physical science then we talk about we are writing the numbers in scientific notation.

In a lesson on indices, Teacher A also referred to the 'convenience' of writing numbers in standard form. He claimed, 'it made life easy' instead of writing very long numbers like the distance from the earth to the moon or the diameter of the earth, one could write it in

a 'short and convenient form'.

## Episodes Referring to Analogies

Just over 20% of the episodes using contextualisation made use of analogies and metaphors based on everyday experiences. An example of an analogy made was an analogy between directed numbers and peoples' names and surnames. The teacher was trying to emphasise the need to write the numbers with their correct signs (directed numbers):

Teacher A: For example, $3x - 4y = 24$ whereby you have to make $y$ the subject of formula. Some of you are writing $4y = -3x + 24$ but, you must write down the number with the sign [referring to the sign of $4y$].
Normally when you write down your name you write also your surname, do also the same with the numbers. Write down what it deserves, it deserves its sign; you also deserve your surname.
So we will have $-4y = -3x + 24$ and therefore $y = \frac{3}{4}x - 6$.
So what is the gradient of the line $3x - 4y = 24$?
Learners: ¾ [chorusing].
Teacher A: What is the y-intercept of $3x - 4y = 24$?
Learners: – 6 [Some learners responded as 6].
Teacher A: People please give the correct surname of the number. So therefore, the answer is...
Learners: – 6 [chorusing].

Further analogies were made between the gradient of the graph and the slope of a mountain, as well as, analogies between an equation and a 'balance' with the two sides 'weighing' the same. The emphasis was on the fact that for the 'balance' to remain 'balanced', whatever is done on the one side of the 'balance' should be done on the other side of the 'balance'.

## Episodes Referring to Common Objects

Just below 10% of the episodes referred to common objects. An example of an episode that related to a common object was observed in a lesson on the calculation of volumes of revolution by Teacher B. In this case a portion of the $y = x^2$ curve was rotated about the $y$-axis and the resulting image was related to a wine glass (see Figure 1).

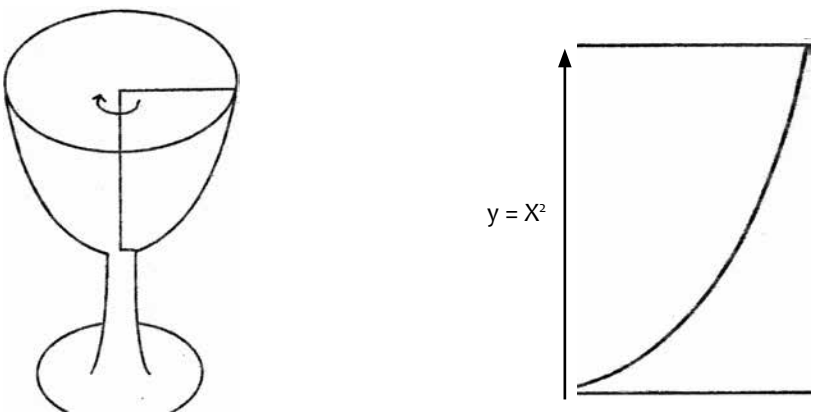


**Figure 1. The wine glass** (adapted from Rhodes, 1998, p. 127)

Figure 1 was one of the images that were referred to in trying to explain how integration could be used to find the volume of revolution about one of the coordinate axes, in this case the y-axis.

An example of how wine glass was used in the lesson is provided here:

Teacher B: So if you look at the first sketch [referring to figure 1], there is part of the sketch of the curve $y = x^2$. Can you see that if you rotate it around the y-axis for one cycle you will get the top part of the glass on the right hand side?

Learners : Yes [chorusing].

Teacher B: Now with that in mind, you should realise that we are not going to work with glass, but we are going to work with solids and not thinking about glass that is open at the top. So we are going to work with solids of revolution and finding the volumes of solids.

In the same lesson, Teacher B had a wine glass, glass cylinders, cones and pyramids to revise the calculation of volumes of these solids, before the use of integrals to calculate the volumes of solids was introduced.

### Episodes Referring to Images from Out-of-school Experience

Only 2% of the contextualised episodes referred to images from out-of-school experiences. It should be noted that the quantification of episodes relating to images from everyday life is difficult because most classroom activities involve some sort of imagery, either mental or visual (Mayoh & Knutton, 1997). The images for this study where presented as line drawings in textbooks and on the chalkboards by the teachers. Of all images presented, only one had contextual significance and it was an image on the distance of an ant from a spider, which came from an activity in the textbook on coordinate geometry.

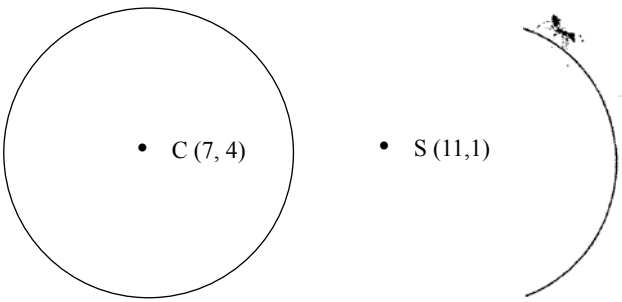


**Figure 2. The spider and the ant** (adapted from Coulson, 2006, p. 78)

The image (figure 2) from the New Namibian Syllabus Mathematics (book 2) by Coulson (2006, p.78) was accompanied by the following questions that the learners had to answer.

a. Calculate the distance between the points C (7, 4) and S (11, 1).
b. An ant crawls around the circumference of a circle with centre C, radius 3 cm. What is the ant's greatest distance from a spider at S? (The diagram is not to scale.)

## Episodes Referring to Industry

While no episode referring to industry was observed during the lessons, an example of such an application came forth during an interview with Teacher B. Asked about a particular instance when context was used in class, Teacher B responded:

"For example, when you try to find the maximum volume for instance of producing a tin. This can be a fruit tin and you want to produce it with a certain amount of metal to make sure that you produce the tin that produces the maximum volume and to use as little of the metal to get the volume that you need this is in context with differentiation".

Teacher B's response gave a context relating to industry pointing to the production and packaging of goods and in this particular instance referring to the production of tins, unfortunately this episode was given outside the actual teaching.

## Discussion of Results

The two research questions are discussed in this section of the presentation.

**Research Question #1:** *To what extent is contextual teaching and learning applied in grade 11 and 12 mathematics classrooms in secondary schools in Gobabis?*

It was observed that an average of 1.8 episodes per lesson referred to everyday experiences of either the learners or the teachers. This observation is less than half the frequency recorded by Mayoh & Knutton (1997) and it is only about a quarter of the frequency recorded by Kasanda et al. (2005) in their studies on the use of CTL in science lessons in the UK and in Namibia respectively. This however, should not be used as an indication that the mathematics teachers were less competent in contextualising their lessons than the science teachers observed in the studies by Kasanda et al. (2005) and Mayoh & Knutton (1997). This is probably because of the nature of mathematics, which sometimes does not allow contextualisation to take place especially at senior secondary school level. The topics observed i.e. Algebra, Coordinate Geometry, Indices, Trigonometry, Polynomials and Graphs might have had a bearing on the extent to contextualisation took place. For example algebra, coordinate geometry trigonometry and graphs were identified by teachers in the study by Akpo (1999) as difficult topics to teach.

The fact that the teachers initiated all everyday contexts observed in this study is rather worrisome, especially given the fact that the Namibian school curriculum rests on a learner-centred approach. In the learner-centred approach emphasis is on the needs, interests, and experiences of the child (Kasanda, 2007). Thus, learners ought to be actively involved in the learning process, learning should be related to their lives and experiences, learning should be an empowering and enlightening experience that creates awareness, competencies and attitudes that will enable the learners to take control of their lives (Villet, 2004). This observation therefore seems to suggest that our teachers are not fully implementing learner-centred teaching and learning, an observation also echoed by other researchers (Kasanda et al., 2005; Mpofu, 2002 cited in Kasanda, 2007).

Very often, the lack of resources (such as textbooks) and large classroom sizes are blamed for the non-use of learner centred methodologies (Kasanda, 2006). However, with the current study it came to light that while School A had large numbers of learners in class and no mathematics textbooks for the learners as opposed to School B, where all learners had mathematics textbooks and the numbers of learners per class was significantly

smaller than School A. The use of everyday contexts was higher at School A. This can be an indication that a lack of resources and a high teacher-learner ratio is not necessarily 'the major' hindering factor when it comes to the implementation of CTL and learner-centred teaching. However, it may suggest that other factors are at play, which may include the creativity, exposure and commitment of the teacher.

**Research Question #2**: *What types of everyday contexts are used in the NSSC mathematics classrooms in secondary schools in Gobabis?*

The Mayoh & Knutton (1997) taxonomy was used to identify the types of contexts used (see, Appendix 1). From the results, it became clear that not all the types of contexts in the taxonomy featured in the lessons observed. This observation could be based on the fact that the taxonomy was developed in the UK and not in Namibia (Kasanda et al., 2005) accordingly the differences in terms of culture, teacher training, availability of resources and access to resources could be responsible for the observed differences and the non-use of some types of contexts in the taxonomy. It is also important to note that the fact that the instrument was developed for use in science classrooms and not necessarily in mathematics classrooms and the nature of the topics observed also had a bearing on the types of contexts used.

It is sad to note that none of the episodes referred to industry especially given the constant criticisms levelled against the Namibian education system by captains of industry (e.g. Pupkewitz, 2006) in a local media in an article titled: On The Crisis of Education). The Namibian education system is said to produce graduates that are not able to perform in industry. Therefore, the teachers should include contexts relating to industry when teaching their subjects. On the other hand, industry should also be prepared to help in terms of providing experts from industry to help the teachers, as well as, providing the tools or equipment needed to properly demonstrate the relevance of the subject matter to aspects of industry. This is especially true given the fact that most, the teachers in the classrooms are not experts of industry nor did they work there to experience the application of mathematics to most aspects of industry. While the experts from industry may not have the knowledge of teaching, they will certainly be helpful especially if they are to work hand-in-hand with qualified mathematics teachers to conduct presentations or demonstrations on particular topics or aspects of mathematics that have been identified.

## Conclusion

Not all contexts in the taxonomy suggested by Mayoh & Knutton (1997) were observed in the mathematics lessons. It was found that none of the contextualised episodes referred to the mass media and industry. Further, none of the episodes attempted to develop the skills of the learners for use in everyday life (see Table 2). However, justifications for the observed results may be due to the fact that the taxonomy might not be relevant for use in developing countries as it was developed based on observations in an industrialised nation and in science. In addition, the nature of the topics observed in mathematics had a bearing on the contexts used.

Contexts were used solely by teachers mainly as a primary strategy for exposition, question and answer and as part of assessment tasks. While the use of contexts as a primary strategy is plausible, the fact that none of the contexts were initiated by the learners was worrisome, especially given the value that the Namibian curriculum places on the needs, interests and experiences of the learners as it is based on the learner-centered

paradigm (see Table 3). Therefore, the teachers should create a conducive environment in which learners express themselves and refer to their experiences without fear.

The study concluded that CTL was not fully implemented because of a lack of resources. Further, the heavy teaching load of the mathematics curriculum limited the extent to which CTL was implemented.

Finally the findings of this study are consistent with findings of other studies on contextual teaching and learning (Kasanda et al., 2005; Mutemeri & Mugweni, 2005; Glynn & Scott, 2003; Mwakapenda, 2001). This seems to suggest that there is a long way to go before contextual teaching and learning is fully understood and implemented in the mathematics classrooms in the secondary schools in Gobabis.

**Recommendations**

In view of the findings reported in this study, the following recommendations are made.

There should be extensive training of teachers through pre-service and in-service training to ensure that they are teaching and learning techniques that encourage the use of contexts in their classrooms.

The Namibian mathematics curriculum should be revised to include alternative assessment methods that will give the learners and the teachers a chance to solve real world problems by applying mathematical concepts and ideas and in the process engaging in CTL.

The implementation of contextual teaching and learning of mathematics should start at earlier grade levels so that cognitive and meta-cognitive learning skills and critical thinking skills of the learners can begin to develop at an early age. In this way students will be able to talk about their own experiences with mathematics beyond the classroom classrooms.

The teachers should move away from simply using the questions in the textbooks, most of which are of foreign origin. They should make their own relevant contextualised questions that reflect the learners' immediate environment.

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