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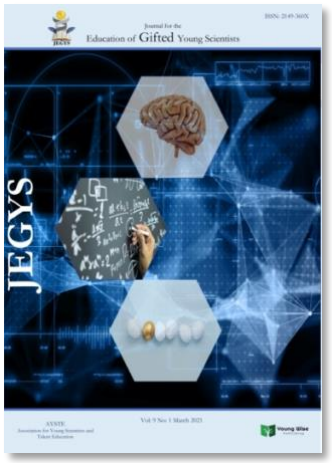

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From the Editor: Talent development in developing and underdeveloped countries? or Talent development in developed countries? and in which development period of the student?

Abstract
Talent development policies vary from country to country. It even varies according to the level of development of the countries. How to take action in this dynamic structure is very important. JEGYS differs from other academic journals with the articles it publishes and guides countries' talent development policies.
Keywords:
Talent development, future perspective, underdeveloped countries

Dear Authors, Readers, Reviewers, Editors

I notice that JEGYS is submitted to articles from authors in either developing or underdeveloped countries. In order for JEGYS to achieve its goals, I ensure that these articles go through a quality review process and are published. Of course, we also published articles from developed countries, but not so much. This situation brought some questions to my mind in the management of an academic journal aimed at talent development. The answers to these questions will perhaps shape our vision in the future.

Developing countries no longer have a problem attracting the talented people they want. It is no longer a guarantee that they will not have problems in the future. The reason for this is as if the pandemic showed us a little. However, as academics and educators, how should we practice in the situations of raising talented individuals in developing and underdeveloped countries in order to create a perspective for practitioners? How should we differentiate education according to them? We need to answer your questions.

Young Wise Publishing moved to the UK, the publishing center of the world, to develop and realize its vision. As a company seeking answers to these questions I asked as the editor of JEGYS, it is also waiting for an answer. It is difficult to develop a formula yet, but I wanted to present you, our esteemed academics and readers, a visionary perspective of an academic journal that aims at talent development.

We are closing the challenging 2021 with success. Seriously and truly, I would like to thank everyone who believed and trusted us, JEGYS.

In this issue, Margaret Moloto and France Machaba from South Africa contributed their article "Grade 6 teachers' s mathematical knowledge for teaching the concept of fractions", O Ndivhuwo P Netshivhumbe, Awelani V Mudau from South Africa contributed article " Teaching challenges in the senior phase natural sciences classroom in South African schools: a case study of Vhembe district in the Limpopo province", Vimbi Petrus Mahlangu from South Africa contributes his article "Enhancing student giftedness in open distance e-learning through quality assurance using Donabedian steps", Matshediso Rebecca Modise from Sourh Africa contributed her article "Exploring early childhood centre managers' perceptions of their roles in promoting developmentally-appropriate physical environments in South Africa", Hlamulo Wiseman Mbhiza, Dimakatjo Muthelo and Kabelo Chuene from South Africa contributed their article "We need to make up for the gap: University student teachers' difficulties associated with basic algebraic manipulations", Roy Venketsamy, Lyndsey Smart and Zijing Hu from South Africa contributed their article " Creating and leading a learning environment in diverse Foundation Phase classrooms in a South African school", Hannah Perpetua Muzembe, Maphetla Magdeline Machaba and Modise Matshediso Rebecca from South Africa contributed their article " Implementing the updated early childhood development curriculum in Zimbabwean primary schools: social validity based on practitioners' views".

We are working hard to ensure that JEGYS continues to be the most followed, cited, read and trend-setting academic journal in the field of education. I thank the referees, editors, authors and designers for their contributions.

Best regards
Dr. Hasan Said Tortop
Editor-in-Chief of the JEGYS

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Research Article

Grade 6 teachers' s mathematical knowledge for teaching the concept of fractions

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Abstract

This article reports on two case studies in which we explored two Grade 6 teachers' mathematical knowledge for teaching the concept of the fraction. We were interested in the mathematical knowledge teachers need to have and are able to use to teach fractions. Of the two teachers who were observed and interviewed, one (Rose) explained the concept of the fraction by emphasising an understanding of mathematical concepts. She did this by using various modes of representation to teach the concept of the fraction and fractional manipulatives. On the other hand, the second teacher (Eddy) focused on procedural knowledge. Eddy used a traditional method to teach fractions, encouraging learners to memorise rules without necessarily understanding them. The learners followed the rules blindly because Eddy did not tell them how the rules originated.

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Introduction

The content area of fractions has long proved to be complicated and troublesome for learners to master. Van de Walle, Karp and Bay-Williams (2010, p.313) identified several possible factors contributing to the poor understanding of fractions. They provide reasons for learners' difficulties with fractions as follows:

- fractions have many descriptions, such as part-whole, measurement, division operator;
- the written format of fractions is strange to learners;
- the conceptual understanding of fractions is ignored in instructions; and
- whole-number knowledge is overgeneralized by learners.

Pienaar (2014) argues that one of the reasons teachers experience difficulties when teaching fractions is the way in which mathematics as a subject is viewed in the South African curriculum. Acknowledging the reasons provided above, we believe that because the concept of fractions is one of the topics in the mathematics curriculum that learners find difficult to master, it is important that learners are taught the concept meaningfully and effectively. Teachers' mathematical knowledge for teaching fractions plays a significant role in this case, especially in primary schools or at the elementary level. The Curriculum Assessment and Policy Statement (CAPS) for Foundation Phase Mathematics, Grade R-3 (Department of Basic Education [DBE], 2011) outlines Grade 2 fraction sub-topics such as the use and

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naming of unitary fractions including halves, thirds, and fifths, recognising fractions in diagrammatic form and writing fractions as one half ($\frac{1}{2}$). This implies that the teaching of fractions in primary schools starts in Grade 2 and progresses into the higher grades. As these fractional concepts advance, at Grade 5 level learners are expected to have mastered fractional concepts such as comparing and ordering fractions to at least twelfths, adding and subtracting fractions with the same denominators, mixed numbers, and recognising and using the equivalency of fractions as outlined in the CAPS: Intermediate Phase Mathematics, Grade 4-6 (DBE, 2011).

Problem of Statement

It appears that many South African teachers struggle to master the content of the mathematics they teach (Bansilal, Brijlall & Mkhwanazi, 2014). Taylor and Vinjevold (1999), Carnoy, Chisholm and Chilisa (2012) observe that over the past years, ongoing low learner performance in mathematics has led to increasing interest in understanding how teachers' pedagogical practices and content knowledge contribute to patterns of poor academic performance. Research and evaluation of mathematics interventions point to a lack of foundational mathematical knowledge as one of the key factors in poor performance.

In addition, Fleisch (2008) maintains that poor performance starts early in the foundation phase where learners acquire basic skills that they need to further their studies. This is where primary school teachers should equip learners with the necessary mathematical knowledge, skills, and attitudes. The most pressing question is why these learners have only superficial and inadequate knowledge of fractions when the curriculum advocates the teaching of an understanding of fractions.

In South Africa, mathematics performance in Grade 5 is not satisfactory. In the years 2011–2013, the DBE (DBE 2011, 2013) administered the Annual National Assessment (ANA) in an effort to improve the quality of education and to identify the weaknesses or knowledge gap that South African learners were facing in Mathematics. The ANA reports for 2011 and 2012 showed that the performance in mathematics of Grade 6 learners was below 50% (DBE, 2011, 2012). An analysis of this report suggested that teachers' poor content knowledge when teaching fractions and their incorrect methods of teaching fractions were two of the reasons for South African learners' poor performance in national assessments in mathematics.

Theoretical Framework and Literature Review

There will not be any effective teaching and learning if teachers do not know the subject they are teaching. Ball et al. (2008) argue that teachers must know their subject well, or they will be unlikely to have the information they need to help their learners learn. Ball et al. (2008) add that simply knowing the subject well is not good enough for teaching as teachers should know mathematics in ways that are useful in making sense of learners' mathematics work and in choosing powerful ways to represent the subject in a way that is understandable for learners

In this article we have used Mathematical Knowledge for Teaching (MKT) as a theorical framework. Mathematical knowledge for teaching refers to the knowledge that is specific to the teaching profession as opposed to the kind of knowledge used by other professions such as engineering and accounting. Teachers need to have adequate, in-depth mathematical knowledge to teach their subject. Ball et al. (2005) ask what teachers need to know, and to be able to do, to successfully teach mathematics.

Ball, Hill and Bass (2005) focus explicitly on *how* teachers need to know the content they are teaching. They argue that teachers need the *how* and *where* to *use* mathematical knowledge in the practice of their teaching. In their study, they observed the demands of teaching mathematics and concluded that these require mathematical knowledge and skill.

Ball, Thames and Phelps (2008) refer to mathematical knowledge for teaching as the knowledge required in everyday tasks, such as explaining, defining, and representing concepts to learners, listening to learners' talk, working with learners' thinking or ideas, commenting on learners' work and controlling their work. This suggests that everyday tasks should be carried out effectively. The teaching of fractions demands that teachers have the mathematical knowledge and skills to teach the concept , in this case to Grade 6 learners. Mathematical knowledge for teaching requires fractional mathematical reasoning, which most adults do not regularly require.

Many of the subtopics that form part of learning and teaching fractions, such as comparing and ordering common fractions, including tenths and hundredths, adding and subtracting fractions in which one denominator is a multiple of another, identifying whether fractions are proper, improper or mixed, converting fractions to percentages and decimals, and equivalent fractions are introduced in Grade 6. These require a teacher with a deep understanding of fractions to explain concepts so that learners understand them.

Teachers should know how to introduce, explain and represent fraction concepts using models or concrete objects to encourage abstract thinking in their learners. These concepts should be taught or conveyed to learners in a way that

allows them to grasp or understand them. These researchers believe that before teachers can teach algorithms or procedural methods to solve fractions, they should consider the conceptual understanding of fractions.

Ball et al. (2008) outline the domains of mathematical knowledge for teaching (MKT) that teachers need to carry out their work as teachers. They indicate that teachers require a great deal of knowledge and expertise in teaching the subject matter, as shown in Figure 2.1 below.

According to Ball et al. (2008), the teacher's knowledge, as indicated in Figure 1, is divided into two domains namely *subject matter knowledge* and *pedagogical content knowledge*. Subject matter knowledge has three domains. The first is common content knowledge (CCK), referred to as the mathematical knowledge that anyone might have. Examples of common content knowledge include knowledge of algorithms and procedures such as adding fractions, comparing fractions, changing improper to proper fractions and recognising wrong answers.

Specialised content knowledge (SCK) is defined as the mathematical knowledge and skill needed specifically by teachers in their work of teaching; it is also used when assessing learners' errors. The last domain is horizon content knowledge (HCK). Pedagogical content knowledge, according to Shulman (1986), also has sub-domains, namely knowledge of content and teaching (KCT), knowledge of content and students (KCS) and knowledge of content and curricula (KCC). All these categories – common content knowledge (CCK), horizon content knowledge, specialised content knowledge (SCK), knowledge of content and students (SCK), knowledge of content and teaching (KCT) and knowledge of content and curriculum form the practice-based theoretical framework of MKT.

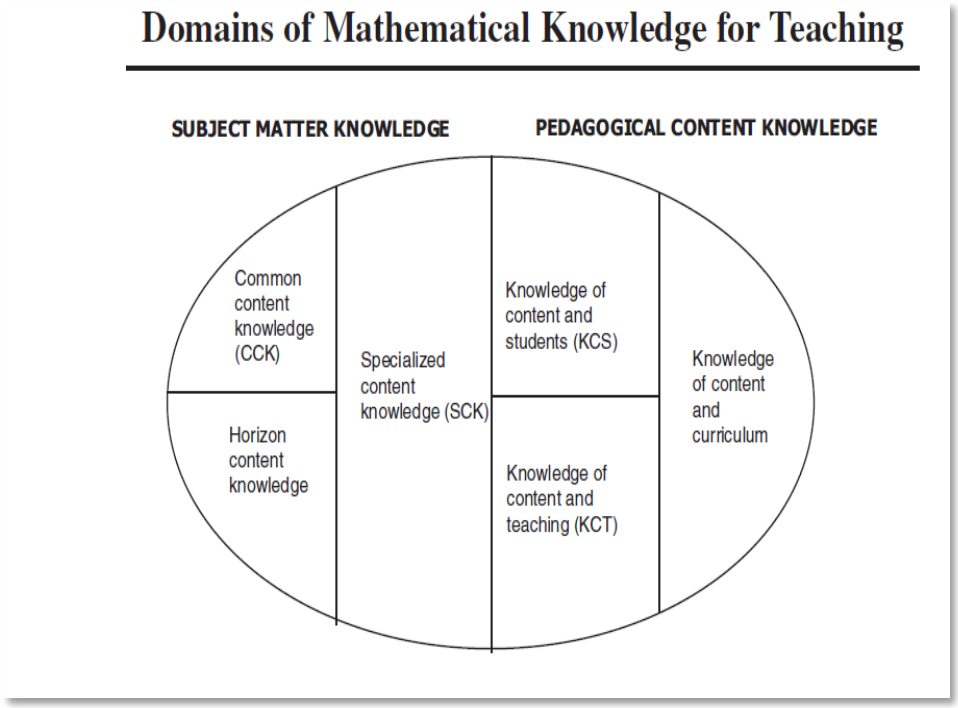


Figure 1.
Domains of Mathematical Knowledge for Teaching (MKT)

Among the sub-domains identified by Ball et al. (2008), *specialised content knowledge* requires the teacher to have a deeper understanding of fractions that will allow him/her to explain new ideas, work out mathematical fraction problems in various ways and analyse learners' explanations. This *specialised content knowledge* is unique and exceptional since it allows teachers to apply various ways of solving mathematical problems. It is vital because it does not channel learners' thinking but allows them instead to explore.

It would be difficult for a teacher to teach learners about fractional mathematics concepts without knowing the content. It is generally accepted that what a teacher teaches, and how this is taught is a task requiring the teacher's own knowledge of the subject. Mathematics teachers should be knowledgeable about the mathematics they are teaching. Ball et al. (2005) argue that specialised content knowledge includes the teacher's ability to use content knowledge to access different representations and the knowledge of different methods for solving mathematics problems that may arise in their teaching.

Balls' notion and Shulman's pedagogical content knowledge (PCK) are intertwined or interwoven. In his presidential address, Shulman (1986) pointed out that teaching entails more than knowing the subject matter. He indicated that besides the content knowledge and curricular knowledge, teachers need a third type of knowledge. He

recognised a special domain of teacher knowledge which is referred to as pedagogical content knowledge (PCK). He regarded the knowledge of teaching and the knowledge of the subject matter as equally important. Shulman (1986) advised teachers not to separate content knowledge from pedagogy because both are needed if they are to carry out their work effectively. He argues that teachers need to know and understand more of their subject than other users because teaching requires a transformation of knowledge into a form that learners can understand.

Shulman's (1986) notion of PCK is viewed as the ability of teachers to use their knowledge of mathematics to break down, represent, formulate, explain, illustrate and make the concepts understandable to learners. This emphasises the idea that mathematics teachers should use their mathematical knowledge to explain fractional concepts and deliver them to learners in a way that learners fully comprehend.

Shulman (1986) also points out that teaching involves more than knowing the subject matter; teaching also entails transforming this knowledge for the learners in an understandable manner. He further argues that besides knowing the content well, the teacher needs to know how to deliver or convey his or her knowledge in such a way that the learners understand it. This means the teacher should know the mathematical concepts of fractions well to be able to deliver them to learners in a way that they can be comprehended. Teachers are, therefore, urged to apply Shulman's (1986) ideas when teaching fractions.

Teacher content knowledge should represent a deep understanding of the concepts to be mastered by learners. Adler and Davis (2006) argue that teachers' mathematical knowledge is an important factor in learners' success. Teachers' mathematical knowledge has an impact on their classroom teaching. Adler and Davis (2006) argue that a teacher requires a deep and broad understanding of mathematics.

Ball et al. (2004) propose eight categories of mathematical teaching that teachers frequently engage with. These eight categories are the tasks of teaching that occur most often in teachers' work. Kazima, Pillay and Adler (2008) reduced the initial eight categories/aspects to six because they concluded that some of the them overlapped.
The six categories identified by Kazima, Pillay and Adler (2008) are as follows:

- *Defining,* which implies that the teacher provides a definition of a concept to learners.
- *Explaining,* which means that teachers explain problems to learners.
- *Representation,* which means that teachers represent an idea in a variety of ways.
- *Working with learners' ideas,* which means teachers engage with learners' expected and unexpected mathematical ideas.
- *Restructuring learners' tasks,* which refers to simplifying a problem or making it more complex.
- *Questioning*, which refers to posing and responding to questions as the lesson proceeds.

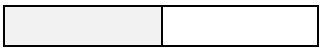
Three of these six categories, namely Defining, Explaining, and Representation were used in this study as indicators of teachers' mathematical knowledge or lack thereof.

Best Practices in Teaching Fractions

Ball et al. (2005) point out that for teachers to teach mathematics well, they need to break down or simplify their mathematical ideas to make them accessible to learners. This means that teachers need to know how to do mathematics and how to use mathematics in practice (Adler, 2004). Van de Walle (2013) observes that fractions are complex but important concepts in mathematics; they are used frequently in various measurements and calculations. The teaching of fractions requires teachers to shift their emphasis from the learning of rules to the development of a strong conceptual basis for fractions.

The Development and Definition of the Fraction Concept

Bassarear and Moss (2016) note that the word "fraction" is derived from the Latin word *fractus*, which comes from the word *frangere*, meaning to break. A fraction is a breaking of something that is a whole into smaller, equal parts. When we work with learners, we talk about the concept of a half. What does it mean and what is a half? In most cases, we take for granted that learners know the meaning of the word and conclude that they understand it. At some point in their lives they have shared things such as a pizza or a pie. Learners know how much half a pizza is. They know that when sharing a pizza with someone, the two pieces should be the same size (equal). Once it has been established that they understand the concept, we can build on it. If they know that a half is one of two parts that are the same size, then they should be able to understand that thirds are three parts of the same size, fourths are four equal parts and so on. This forms the basic construct for fractions. Van de Walle (2016) indicates, however, that the concept of fraction tells us only about the relationship between the part and the whole. Figure 2 provides an example of a fraction as part of a whole, as indicated by Van de Walle (2016):



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Area Model

This whole is a **rectangle**; the whole is divided into two **equal parts**. **Each** part is half of the whole; Two **parts**, therefore, make one whole.

Teaching Fractions by Unpacking of the Concept of Fractions

The unpacking or explanation of fractions requires a teacher to have a deep understanding of the concept. In this case, the teacher should start with learners' prior knowledge. Tall (1989) refers to learners' prior knowledge as cognitive roots that are essential for developing a concept by connecting and laying the foundation for learners' conceptual thinking. On the other hand, Essien (2009) talks of the first encounter, emphasising the importance of starting with learners' prior knowledge and connecting it to new knowledge. These researchers argue that in any pedagogical practice, the first counter needs to be addressed using mathematical concepts. The unpacking of a concept also requires the teacher to design the first counters as well as cognitive roots. The teacher should explain what a fraction is to learners. The teacher could pose questions to learners to arouse their interest about the topic or simply to establish their prior knowledge of fractions.

The teacher will then involve learners by defining, explaining and representing what a fraction is. At this stage, the teacher should use models to help learners understand fractions; a variety of models may be used to foster deep conceptual understanding, such as area models, length models and set models. Cramer and Wyberg (2009) indicate that the effective use of models in fraction tasks plays a significant role; learners appear to explore when a variety of models is used, and this builds their understanding of fractions (Cramer & Wyberg, 2009).

Different and appropriate representations of models of fractions broaden and deepen learners' understanding and help them to learn more easily. Van de Walle (2004) identified uses for models in the classroom, for instance to help learners develop new concepts and to make connections between concepts and symbols, and to assess learners' understanding.

When introducing fractions, the fraction symbol should be delayed until the fraction concept is stable. Van de Walle (2009) points out that the fraction symbol can prove to be a confusing notation for children, so learners should instead be encouraged to write the fraction names in words, for example 3 quarters or three quarters instead of $\frac{3}{4}$.

When unpacking the fraction concept, teachers are encouraged to refrain from using traditional methods of teaching. For instance, it seems that learners are encouraged to memorise rules without knowing where they come from. This may result in learners simply becoming blind followers of the rules without understanding them. Teachers are urged to use models instead of enforcing rules to overcome this. Using models makes fractions more concrete for the learner, and not just numbers on top of each other with no meaning. The learner will be able to estimate the answer before calculating, and evaluating the reasonableness of the final answer. Learners should be motivated to discover the fraction concept on their own by drawing or folding a piece of paper into equal parts and explaining these parts.

In this regard, Stohlmann, Cramer, Moore and Maiorca (2013) argue that if learners are taught the procedural way of working out fractions first, they are **less likely** to master the fraction concept. They believe that understanding the fraction concept first is **more powerful** and more generative than remembering mathematical procedures.

Teaching of Equivalent Fractions

Lamon (2002) explains that equivalence between fractions refers to the fact that many different fractions can be used to name the same quantity, depending on how the quantity is subdivided. Van de Walle (2016) adds that equivalent fractions are a way of describing the same amount using different sized parts; equivalence is about naming the same fractions in more than one way. Van de Walle (2016) argues that models may be used to develop conceptual understanding of equivalence, as illustrated in Figure 3 below. He explains that two fractions are equivalent if they are representations of the same amount.

Van de Walle and Lovin (2006) expand on the concept of equivalence when they state that to help learners create an understanding of equivalent fractions they should use models to find different names for a fraction. They (Van de Walle and Lovin, 2006, p. 66) provide the following important point about equivalent fractions: "Two equivalent fractions are two ways of describing the same amount by using different-sized fractional parts. For example, in the fraction $\frac{6}{8}$, if the eighths are taken in twos, then each pair of eighths is a fourth. The six-eighths then can be shown as $\frac{2}{8} = \frac{1}{4}$

and $\frac{6}{8} = \frac{3}{4}$ can be shown as three fourths". Figure 3 illustrates this:

Figure 3.
Equivalence Fractions

According to Gould (2005), set models can be used to develop the concept of equivalence. Petit et al. (2010) believe that length models are very important in developing learners' understanding of fractions; length or measurement models can be paper folding strips, where one piece is measured in terms of the smallest strip. Each length is a different colour for ease of identification. Petit et al. (2010) note that strips of paper are also length models; these can be folded to produce fraction strips by learners. The teacher is required to do the activity with the learners to develop the concept of equivalent fractions and demonstrate or show equivalence in fractions. Working with learners will allow them to develop the concept on their own. Van de Walle et al. (2010), Cramer and Wyberg (2009), and Lamon (2008) emphasise that concrete representation is key if learners are to comprehend fractions. Learners can be asked to use crayons to colour the strips. Learners can also be asked to take a piece of paper from an exercise book; the teacher will then instruct them to cut the piece of paper into nine strips that are exactly equal in size and shape.

Teaching Comparing and Ordering of Fractions

Petit et al. (2010) explain that when looking to see whether two or more fractions are equal, we are comparing them by identifying which is smaller or bigger than the others. Van de Walle (2016) adds that comparing fractions means checking which part of the same whole is bigger or smaller than another part. When comparing fractions, the whole must always be the same. A fraction wall chart can also be used when comparing fractions (Van de Walle, 2016). Using a fraction wall allows learners to see that all fractions have the same whole, and that $\frac{1}{2}$ is greater than $\frac{1}{3}$ and also greater than $\frac{1}{4}$ and that $\frac{1}{3}$ is greater than $\frac{1}{4}$ and so on, as illustrated in Figure 4

Petit et al. (2010) note that comparing fractions using rules can be effective in arriving at the correct answer, but if learners are taught these rules before they master the fraction concept of relative sizes their chance of making mistakes is high. They stress that using rules requires no thought about the size of a fraction. If learners are taught these rules before they are encouraged to think about the relative size of different fractions, they may be less likely to develop a number sense when it comes to fraction size.

Petit et al. (2010) regard the number line model as a good one to help learners to develop a better understanding of the relative sizes of fractions. They argue that the number line should extend beyond 1 when comparing fractions like $4\frac{1}{2}$. The main aim of using models is to give learners a grounded understanding of the concept, and to avoid simple memorisation of an algorithm method. Learners should have a sound understanding of comparing fractions and their ordering. Cramer and Whitney (2010) recommend that teachers help learners to understand the meaning of the fractions, to make sense of them and to avoid rote procedures. Learners should also be able to understand that fractions are numbers, as well as learning how to use models. Fazio and Siegler (2011) argue that misconceptions with fractions stem from a lack of conceptual understanding.

When using the fraction wall illustrated in Figure 4, learners should notice that the fraction with the bigger denominator is the smallest when comparing fractions with the same numerators.

Exercises like this, using greater than signs **(>)** and less than signs **(<)** can be given to learners to work out.

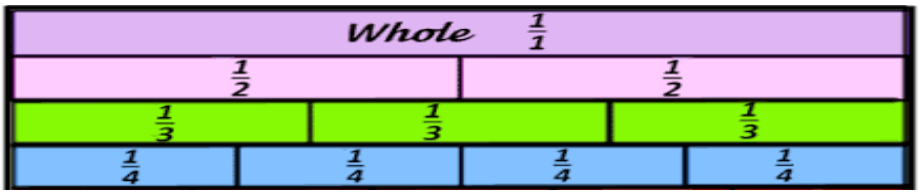

Figure 4.
Fraction Chart

Once learners have mastered visual representations, they should be able to create their own visuals to work out fractions

Method

Research Design

The study took a mainly qualitative approach. A qualitative research approach was since the study investigated the practice of intermediate phase teachers from specific schools when teaching fractions. Using a qualitative research approach, the study reports on two case studies in which the researchers explored intermediate phase teachers' mathematical knowledge to introduce, unpack, develop, and define fractions for Grade 6 learners.

Participants

The sample in this study comprised two Grade 6 mathematics teachers from neighbourhood schools. These two teachers were purposefully and conveniently selected as the nearest individuals to serve as participants and based on their considerable experience of teaching mathematics, as indicated in Table 1:

Table 1.

Structures of Participants

Participants	Years of experience in teaching	No. of years teaching mathematics to Grade 6	Qualifications	Gender
Eddy	15 years	10	Primary teacher's Diploma/Degree	Male
Rose	25 years	16	Primary teacher's Diploma/Degree	Female

Data Collection

The data were collected using two methods: observing and interviewing teachers who offered mathematics at a primary school. The main data collection method was observation. A researcher observed the teachers in practice, taking the role of a non-participant observer (complete observer) in the classroom. Two teachers were observed as they went about their work of teaching fractions to Grade 6 learners. Three double lessons per teacher per school were observed. One lesson is 30 minutes in length, and six lessons by each teacher were observed, with a total of 12 lessons. However, this article reports on one observed lesson only by each teacher, which concerned comparing fractions. The lesson observation notes were transcribed and chunked into evaluative events/episodes.

Data Analysis

Once the data from the observations and interviews had been collected, the researcher used as observation schedule to check whether the categories identified during the observation corresponded to the categories condensed by Kazima (2008) from the eight aspects developed by Ball et al. (2004).

Kazima et al. (2008) reduced the categories/aspects to three because they concluded that some of them overlapped. The three categories selected were as follows:

- ***Defining,*** which means that the teacher provides learners with a definition of a concept.
- ***Explaining,*** which means teachers explains problems to learners.
- ***Representation,*** which means teachers represents an idea in various ways.

Results

Eddy's Lesson Observations

Category 1: How do teachers introduce, define, explain and represent the concept of fractions to Grade 6 learners?

Comparing and Ordering Fractions

Below is a extract from a lesson in which the teacher (Eddy) defined, explained and represented the concept of fractions in his teaching. LS represents "learners" and L represents "a learner in class", for example, L1 represents Learner 1, L2 represents Learner 2 etc.

00:08–00:09

1. Eddy: Good morning, class.
2. LS: Good morning, sir.
3. Eddy: Sit down.
4. LS: (Sit down and listen to the teacher.)
5. Eddy: Today we are going to learn about comparing and ordering of fractions [turns to the board and writes] ($\frac{5}{7}$; $\frac{2}{7}$;$\frac{6}{7}$;$\frac{4}{7}$;$\frac{1}{7}$). Look at these fractions. What do you realise?

00:10

6. L1: They have the same denominators.
7. Eddy: Yes, they have the same denominators. Comparing fractions like thisis easy because if they have the same denominators, the fraction with the bigger numerator is the biggest. So, who can come and arrange them for us?
8. L2: [Stands and goes to the chalkboard, writes] $\frac{6}{7}$; $\frac{5}{7}$;$\frac{4}{7}$;$\frac{2}{7}$;$\frac{1}{7}$
9. Eddy: Good, this is how we order and compare fractions. The same applies if they have the same numerators; the fraction with the bigger denominator is the smallest. [writes $\frac{1}{3}$; $\frac{1}{5}$; $\frac{1}{7}$;$\frac{1}{4}$;$\frac{1}{2}$ on the board. Someone, come and arrange these fractions from the smallest to the biggest.
10. L3: [Stands and goes to the board and writes] $\frac{1}{7}$; $\frac{1}{5}$;$\frac{1}{4}$;$\frac{1}{3}$;$\frac{1}{2}$

00:20

11. Eddy: You are correct. Clap hands for him. Now because you understand, let us continue comparing fractions with different numerators and denominators. When comparing fractions with different numerators and denominators, we should make them to have the same denominators by looking for the LCM which means lowest common multiple for example [writes on the board] fractions that are multiples of the other $\frac{2}{3}$ and $\frac{1}{6}$ we should multiply $\frac{1}{6}$ by $\frac{2}{2}$ like $\frac{2}{3}\times\frac{2}{2}=\frac{4}{6}$ now because the denominators are the same, we can compare them and the answer is $\frac{2}{3} > \frac{1}{6}$. If they are not multiples of the others find the LCM. (Comparing and Ordering Fractions, Lesson 1)

It is evident from this lesson (line 7) that the teacher, Eddy, went on to explain a rule by saying, *Yes, they have the same denominators. Comparing fractions like this is easy because if they have the same denominators, the fraction with the bigger numerator is the biggest. So, who can come and arrange them for us?* After the teacher had provided an explanation of comparing and ordering of fractions with the same denominator, he then asked if there was any learner who could provide an answer to his explanation of a "rule". It appears that while Eddy was explaining the rules for comparing fractions, he did not explain how this rule originated. He was encouraging learners to master "rules and procedures" at the expense of developing the concept of fractions for them. This kind of teaching encourages memorisation rather than conceptual understanding.

We believe that if the teacher wanted learners to master the concept of comparing and ordering fractions, he should not have started by foregrounding the "rule" *if they have the same denominators, the fraction with the bigger numerator is the biggest.* The teacher could have used teaching strategies that would have allowed learners to discover the rule by themselves. For example, the teacher could have used a number line representation or a diagram representation to develop the concept of comparing and ordering fractions. The teacher's explanation of the rule should have come as a reinforcement of what learners had already discovered through their own investigation. It was no surprise that L2 (in line 8) provided the correct answer $\frac{6}{7}$; $\frac{5}{7}$;$\frac{4}{7}$;$\frac{2}{7}$;$\frac{1}{7}$.

Similarly, as reflected in lines 9 to 11, the teacher used a similar strategy of foregrounding procedures, routines and rules rather than developing the concept so that learners could discover these rules by themselves. Again, as in line 11, Eddy used procedures in his teaching to compare fractions with different denominators.

When Eddy said "*Now because you understand"* it was his assumption that they had understood because he had provided them with the rules and procedures and they repeated these rules, and some of them (L1 and L2) arrived at

the correct answer. Eddy assumed that all learners were at the same level of understanding, without checking whether the other learners understood. If fact, it was not even certain that L1 and 2 had understood the concept of comparing and ordering fractions based on algorithms and routine procedures. Based on his assumption, Eddy moved on to compare fractions with different numerators and denominators. Even at this stage, he taught procedures, saying:

> When comparing fractions with different numerators and denominators, we should make them to have the same denominators by looking for the LCM which means lowest common multiple for example [writes on the board] fractions that are multiple of the other $\frac{2}{3}$ and $\frac{1}{6}$ we should multiply $\frac{1}{6}$ by $\frac{2}{2}$, at the expense of developing the concept. (Eddie)

The teacher used only one form of representation in his lesson, which was number representation. He dominated the lesson by providing rules and procedures without letting learners discover them by themselves. The teacher could have approached this lesson differently if he wanted learners to develop the concept, using a number line, drawing or fraction chart to compare and order fractions. In this lesson, there was no evidence of different representations to teach the comparing and ordering of fractions. When asked to reflect on his lesson during the interview, Eddy implied that teaching by emphasising procedures and rules without considering learners' understanding was the norm in his teaching. This is supported by an extract from the interview:

Researcher: You mentioned that you have ten years' experience in teaching mathematics in Grade 6, and you have taught fractions many times. Do you always teach fractions the way you did this year in the lessons that I observed? Does your teaching develop learners to master fractional concepts?

Eddy: This is the way I normally teach these learners because I just assume that the lower grade teachers have already introduced the fractional concept, therefore I am teaching them rules on how to convert fractions and so on.

From the extract above, it appears that Eddy's teaching had always been dominated by the teaching of rules, without much focus on the understanding of the concepts. He said, *This is the way I normally teach these learners.* Eddy's justification for teaching rules without ensuring understanding of the concept was based on the assumption that teachers of the lower grades had already introduced these concepts and ensured an understanding among learners. Eddy had been teaching in this way for the past ten years.

Rose's Lesson

The second teacher observed was Rose from school B. Her lesson went as follows:

Category 1: How do teachers define, explain and represent the concept of fractions to Grade 6 learners?

Unpacking the concept of fractions

The extract below illustrates how the teacher (Rose) defined, explained, and represented the concept of fractions in her teaching.

00:23

5. **Rose**: [Gives learners an A4 paper sheet each.]
This is the A4 paper, I am going to tell you what to do and you should listen.

6. **LS**: [Listening and paying attention to the teacher.)**]**

7. **Rose**: Fold your A4 paper once and make sure the two parts are on top of each other. Are you following?

8. **LS:** Yes, ma'am

00:26

9. **Rose**: Unfold your papers. What do you notice?

10. **LS:** (Raising their hands.)

11. **Rose**: L1 tell us what can you about the A4 paper.

12. **L1**: The paper has 2 parts now.

13. **Rose**: Do you agree with her, learners?

14. **LS:** Yes, ma'am

15. **Rose**: What else can you say?

16. **L2**: Two parts are equal. We had a whole of the A4 paper but now it is divided into 2.

17. **Rose**: What else can you say about the paper?

18. **L3**: We now have halves no longer a whole.

00:39

20. **Rose**: You are correct. Each part is half of the paper. Now let us fold it twice and unfold and see what happens. How many parts do you see now?

21. **L3:** I see four parts.

22. **Rose:** [Poses a question to L3 who has just answered.] What can you say about these parts?

23. **L3:** They are equal.

24. **Rose:** [Orders learners.] Fold the paper three times now.

25. **LS:** [Doing what was ordered.]

00:45

26. **Rose:** Unfold your paper. (Learners do what the teacher has told them.) How many parts do you see?

27. **LS4:** There are eight equal parts.

28. **Rose:** Do you agree with him?

29. **LS** [Answers by shouting.] Yes, ma'am.

00:49

30. **Rose:** Learners, continue to fold the paper four times and unfold, then five times and unfold and see how many parts you see.

00:54

31. **Rose:** So, learners, we were dealing with fractions all this while and a fraction is part of a whole, half is part of a whole, a quarter is a part of a whole etc., do you understand?

32. **LS:** Yes ma'am.

(Fractional Concept, lesson 1,t ime interval 00:20–00:54)

The extract above illustrates how Rose executed her teaching of mathematical work. The aspects of defining, explaining, and representing were observed in Rose's lessons. In Lesson 1, it was clear that the teacher wanted learners to develop a conceptual understanding of fractions and to recognise the fractional concept on their own. In line 7:

"*Fold your A4 paper once and make sure the two parts are on top of each other".* Line 9, *"Unfold your papers. What do you notice?"* Line 20, *"Now let us fold it twice and unfold and see what happens. How many parts do you see now*?" Line 30, "*Learners, continue to fold the paper four times and unfold, then five times and unfold and see how many parts you see?"*

There was evidence of verbal representation such as half of an A4 paper. In terms of different representations, the teacher could have used other representations such as circular, rectangular or square diagrams, i.e. a diagrammatical representation, on the board, shading some parts of a whole for learners to form a clear picture of other representations. Using A4 paper may lead learners to think that this is the only object to use in the development of fractional concepts.

At this stage of developing the concept of fractions, the Rose had done well because at this stage the teacher should only use verbal expressions, which is what Rose did. The teacher and the learners showed each other halves, fourth, eighths and sixteenths. The only thing she could have added was to allow learners to develop other fraction names such as thirds, fifths, sixths themselves, and the rest would have followed.

It was also evident that the teacher explained and defined fractions for her learners: Line 31 "So*, learners, we were dealing with fractions all this while and a fraction is part of a whole, half is part of a whole, a quarter/fourth is a part of a whole etc., do you understand ?"*

It appears that this was how Rose generally taught mathematical concepts; when asked if she always taught fractions as she had in this lesson, she replied:

Rose: This is how I am teaching. When I introduce a lesson, I make sure that learners understand the concept before teaching them the rules. I want learners to master the concept first. I have realised that mastering the concept is important because after mastering the concepts they learn with ease when teaching them the *how* part of working out fractional rules.

It is evident from the above extract that Rose, when introducing a lesson, would make sure that learners understood the concept before teaching them the rules. Rose seemed to have found the secret of teaching learners a concept with understanding and the benefit thereof. She said, "*They learn with ease."* When asked what she would do to develop

conceptual understanding in her teaching of fractions, she said that in the absence of teaching resources she had to improvise, as indicated in the interview extract below:

Researcher: From your knowledge and point of view, what do you think are the main things a teacher needs to know in order to develop conceptual understanding of fractions for learners to master?

Rose: From my perspective, for learners to understand better, teaching resources should be available and if they are not available, as a teacher I must improvise.

Discussion

The theoretical lens that informed this study on the notion of teaching fractions to Grade 6 learners was drawn from Ball et al.'s (2008) framework, Shulman's (1986) pedagogical content knowledge (PCK) and the constructivist theory.

This section responds to the first research question: How do teachers unpack/introduce, define, explain and represent the concept of fractions to Grade 6 learners? This study revealed that Eddy merely engaged in **explaining** procedures to learners when teaching fractions. He was spoon-feeding learners with mathematical rules; he wanted learners to memorise the rules without understanding where the rules came from. The memorised rules may be forgotten in the long run. Stohlmann et al. (2013) advise teachers not to teach the procedural way of working out fractions, firstly because if they do so, the learners are **less likely** to master the fraction concept. Stohlmann et al. (2013) emphasise that teachers should refrain at all costs from encouraging the memorisation of rules. Ball and Bass (2005) add that for teachers to teach mathematics well, they need to unpack or decompress their mathematical ideas to make them accessible to learners. This implies that if teachers are to teach the concept of fractions, they should know what is expected of them. Skemp (1976) points out that instrumental understanding refers merely to being able to apply a sequence of steps without necessarily knowing why they are being applied in that way, or what they mean; that is, rules without reasons. In contrast, relational understanding is knowing what to do and why, which means that learners should be told where and how the rules originated. Hiebert (1996) also notes that mathematical tasks that encourage learners to use procedures that are not actively linked to meaning or that consist of memorisation are viewed as of lower-level cognitive demand in the learning of mathematical fraction concepts.

Eddy's learners were passive participants in the class. Constructivism (Piaget, 1964) perceives learners as creators of their own learning and as active participants in the learning process; Eddy's learners should have been discovering rules on their own and making sense of mathematics.

The study revealed that Eddy failed to provide learners with the opportunity to discover the mathematical rules on their own (Stohlmann, Cramer, Moore and Maiorca, 2013). They sat and listened to what their teacher was saying. His lessons were teacher-centred and learners were passive participants. Few learners repsonded to the questions he posed, and the majority were passive. Eddy asked: *"Learners, how do we know that a fraction is [a] common fraction?"* L1 answered: "*We know if there is a top number and a bottom number.*" Blaise (2011) observes that teachers use the teacher-centred approach with direct instruction in behaviourism.

In Eddy's first lesson, comparing and ordering of fractions, it was evident that he used procedures, routines and rules that applied to fractions with the same denominator. For example, he said, "*When comparing fractions with different numerators and denominators, we should make them to have the same denominators by looking for the LCM".* To develop the concept of comparing and ordering fractions, he should have used different models such as linear or circular models to represent the concept meaningfully. His old-fashioned approach to teaching may have led to learners making mistakes and developing misconceptions. Sarwadi and Shahrill (2014) embrace the Piagetian view that when learners fail to assimilate or accommodate, a gap is formed in the learning of the concept and this leads to misconceptions.

Furthermore, Eddy's teaching did not resonate with the theory of constructivism (Piaget, 1964), which states that the teacher's role is that of facilitator and motivator. In his teaching, Eddy was not facilitating learning by encouraging learners to take control of their own learning. His teaching was teacher-centred rather than learner-centred (Machaba, 2017). He failed to allow learners to construct their own knowledge and understanding using their existing experiences. The fraction concepts were not fully developed in any of Eddy's lessons; only the mathematical rules were emphasised, which is regarded as poor delivery of content. Van de Walle (2016) notes that rushing to procedures may cause learners to make errors and form misconceptions, and this could hamper their conceptual understanding. Teacher Eddy should have developed the fraction concepts using several models for learners to develop a solid and deeper understanding of fractional concepts. The researcher is of the view that Eddy's way of teaching suggested that his mathematical knowledge for teaching was inadequate because in all the lessons observed, he failed to develop the concept of fractions meaningfully for learners.

The findings reveal that Eddy could not unpack the concept in such a way that learners developed conceptual understanding, although he could explain and define fractional concepts in such a way that learners would understand.

In Ball et al.'s (2008) terms, we could say that Eddy possessed the *content knowledge*, but not the specialised content knowledge that requires the teacher to have a deeper understanding of fractions that would have allowed him to explain new ideas and work out fractional mathematics problems in a variety of ways, and analyse learners' explanations. Olivier (1989) argues that errors are indicators of the existence of misconceptions and happen as a result of many factors, for example the way in which teachers teach fractions. From a constructivist point of view, errors are intelligent constructs of knowledge by learners.

Ball et al. (2008) believe that a teachers should have knowledge of the subject they are teaching. Shulman's (1986) notion of PCK is viewed as the knowledge to teach the subject matter, the knowledge to formulate and present the subject matter so that it is comprehensible to learners. The frameworks of both Ball and Shulman indicate that teachers should know their learners and understand their common difficulties, errors and misconceptions, which means that they should have specialised content knowledge (SCK) and knowledge of the curriculum and their students (KCS). Ball et al. (2008) emphasise that mathematics teachers should use their mathematical knowledge to unpack fractional concepts and deliver them to learners in a way that they will fully comprehend.

On the other hand, analysis revealed that Rose wanted her learners to develop a conceptual understanding and recognise the fraction concept independently. From a constructivist perspective, learners construct knowledge and understanding on their own, connecting their web of ideas. In Rose's first lesson on fraction concepts, she developed the concept successfully by involving learners in an activity in which each learner was folding and unfolding a piece of paper. In this lesson, learners were active participants in their learning, and this resonates with constructivism as the theory specifies that learners are active agents of their own learning process. Rose knew that learners should master the fraction concept before being introduced to algorithms. This is supported by Van de Walle (2009), who argues that teachers should not rush to algorithms as they can delay learners' understanding of the concept.

Rose used verbal instructions and learners were able to understand that they were folding the paper in half, or into a fourth, sixth etc. Learners discovered the concept of fractions on their own. Analysis revealed that there was a clear indication that learners were developing the concept of fractions with their teacher. Learners were actively engaged in this activity, and they were able to discover the fraction concepts on their own. Analysis revealed that Rose used linear modelling when her learners were folding and unfolding the paper to develop and name the fractions, and this is supported by Petit, Laird, Marsden and Ebby (2010) who found that the length model for fractional concepts was important in developing learners' understanding of fractions and naming them. This is supported by Lamon (2008), who points out that the naming of fractions helps learners to use the correct language and to understand the concept of fractions.

In her second lesson on fractional notations, Rose used a circular area model, demonstrating part, whole and equal sized parts with an apple (Cramer and Wyberg, 2009). This resonates with Van de Walle (2007) who believes that teachers should emphasise fractional parts as equal shares or equal sized portions of a whole or unit.

Once she felt that her learners understood the concept, Rose moved to fractional notation where she used an apple as a model. This resonates with Cramer et al. (2008) who support the idea of using a circular area model because they found that these were effective in developing the fractional concept. Rose cut up an apple in front of her learners and asked them to watch what she was doing. She said: "*Look at me, all of you, I cut it like this" (*showing learners how she cut it). The apple was cut or divided into four parts and one part of the apple was given to a learner, with Rose stating: "*I give Mpho this part"* (referring to one part). She then asked the class questions about the parts of the apple such as "*How many parts was this apple divided into?"* Through her teaching, her learners discovered that when we talk about fractions, we are actually referring to **equal-sized parts**. One of her learners (L5) responded *that "[it]t was divided into four* ***equal parts."*** Rose then gave the learners the notation of the concept of fractions symbolically, for example $\frac{1}{4}$. This corresponds to Van de Walle (2016), who argues that representation at this stage is **symbolic.** This is where she should have told learners that $\frac{1}{4}$ is called one-fourth of an apple, not one over four, however. As Siebert and Gaskin (2006) and Cramer and Whitney (2010) emphasise, teachers should avoid expressions such as one out of two, two out of six and so on when teaching learners learners.

These learners understood that the top number represents parts that were used, considered, or taken out, whereas the bottom number indicates the number of equal parts into which the apple was cut. The bottom number also gives the fraction a name, for example a fourth. Rose explained the fraction concept successfully, as is supported by Ball and Bass (2005) who argue that if teachers are to teach mathematics well they need to break down their mathematical ideas so that they are accessible to learners. Rose unpacked the fraction concept in a way learners could understand. Shulman's (1986) notion of pedagogical content knowledge is understood as the knowledge of teaching the subject matter, formulating and presenting the subject matter so that it is understandable for learners.

Ball et al. (2008) refer to mathematical knowledge for teaching as the knowledge required in everyday tasks such as explaining, defining and representing concepts to learners. They argue that teachers require a great deal of knowledge and expertise to carry out the work of teaching the subject matter. Shulman (1986) warns teachers not to separate content knowledge from pedagogy because both are needed if teachers are to carry out their work effectively. He argues that teachers need to know and understand more of their subject than other users because teaching requires a transformation of knowledge into a form that learners can understand.

Conclusion

This study's findings revealed that of the two teachers observed, Eddy did not meet all six criteria when unpacking the fraction concept. His mathematical knowledge was inadequate to explain the concepts successfully. He used a traditional approach to teach fractions, encouraging learners to memorise rules without necessarily understanding them. He used a teacher-centred approach with direct instruction. The learners followed the rules blindly because he did not tell them how the rules originated. On the other hand, Rose followed a learner-centred approach, characterised by: a variety of productive questions; increasedlearner involvement; social, verbal, concrete physical and experiential engagement with fraction concepts; and active construction of ideas by learners.

From the findings, the researchers made the following recommendations.

Regarding the use of models, it is recommended that teachers use different representations such as area models, circular, rectangular models, set models and length models to develop the concept of fractions successfully. Cramer and Wyberg (2009) found that the effective use of models in fraction tasks plays a significant role. Learners seem to explore when a variety of models is used, which builds learners' understanding of fractions (Cramer & Wyberg, 2009).

It is therefore recommended that school procurement committees purchase fractional charts to make the teaching of fractions more effective. It is also recommended that schools have internet facilities to download information related to fractions.

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Research Article

Teaching challenges in the senior phase natural sciences classroom in South African schools: a case study of Vhembe district in the Limpopo province

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Abstract

This paper investigated some of the teaching challenges Senior Phase Natural Sciences teachers' experiences during their classroom practices in some of the rural schools positioned in the Vhembe District, Limpopo Province of South Africa. It was an interpretative qualitative study wherein two Senior Phase Natural Sciences teachers participated in the study. The data of the study was obtained through individual interviews with teachers as well as lesson observations. The findings show numerous challenges in the teaching of Natural Sciences including lack of required facilities and resources. Additionally, the study also reports challenges of lack of parental support, background of learners as well as language of teaching and learning. Consequently, this has impacts on teacher ability to implement Natural Sciences curriculum. Moreover, the findings also show that some of teachers available at schools used teaching experiences to teach Natural Sciences content and are reluctant to use various methods of instruction. Therefore it is suggested that the above mentioned challenges in Natural Sciences teaching need to be addressed so that what is taught and learnt through Natural Sciences curriculum at school can be meaningful to both teachers and learners in their everyday lives.

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Introduction

Qadeer, Tahir & Chishti (2018) reported that professional teachers have the capability in education, classroom management, cooperation with senior teachers and school principals, and have the freedom to create a democratic environment. There are numerous challenges encountered in the teaching of sciences at schools. Ali-Rweide (2019) reports barriers which affect doing experiments like school circumstances and lack of labs, crowded curriculum, large students' number in classes and danger of some experiments. Additionally, all of these barriers may affect the aims that science teachers try to satisfy from conducting experiments, and strategies used for that (Ali-Rweide, 2020). Science teachers are important in the teaching and learning of science at schools and thus there is no development of science education in the universe without teachers' contribution. From anecdotal evidence some science teachers available at schools are teaching different science subjects even though they specialised in one particular area at tertiary level. Teaching outside area of specialisation is a challenge which can results in an increase of teachers' lack of confidence and thus lead to teachers failure to enhance their ability to teach effectively. Additionally, teachers lack of confidence on a subject can be displayed in many ways, for instance when preparing and presenting lesson plan, selecting materials and activities to assist learners to learn, responding questions raised by learners as well as setting up laboratory for practical activities. Science concepts which are difficult for teachers to understand can be transferred

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towards learners incorrectly and create many alternative conceptions. Consequently well trained qualified teachers are required at schools in order to teach and assist learners to relate the ideas of science and address alternative conception. For this point of view researcher investigated challenges in the teaching of Natural Sciences (NS) at Senior Phase level of education.

Literature review

Availability of Well-trained Qualified Science Teachers

Teachers are expected to fulfil different roles these days not like in the past, where it was anticipated that the role of the teacher was to transmit certain information to passive learners and establish whether they were able to reproduce it, unchanged, in tests and examinations. Therefore, schools should have teachers who are qualified and dedicated in order to accomplish their roles as stipulated in the Norms and Standard for education including mediators of learning, interpreters and designers of learning programmes and materials, leaders, administrators and managers, scholars, researchers and lifelong learners, community members, citizens and pastors, assessors and learning area/phase specialists. Ngema (2016) shows that unqualified teachers or qualified teachers who do not understand the nature of science that has to be taught at school result in learners' poor performance. This means that there is a relationship between teacher content knowledge and performance of the learners at school. Budiastra, Wicaksono & Erlina (2020) state that teachers play a central role in the effective dispensation of the curriculum.

Teaching and learning of Natural Sciences (NS) can be effective if a well-trained qualified teacher is available at school to offer the subject. Budiastra, Wicaksono & Erlina (2020) indicated that teachers are supporting factors for a good education and quality of education cannot exceed the quality of a teacher. However, Budiastra, Erlina & Wicaksono (2019a) shows that there are still large numbers of unqualified teachers who teach science at schools. This means that lack of science teachers is a reality that exists in many schools. This result in under-qualified teachers to selects what they could teach and disregard what they could not due to lack of science background (Adeniran, 2020). Furthermore some under-qualified teachers fail to use the scientific equipment and they cannot do science practical investigations with learners because they are deficient in practical investigation skills (Adeniran, 2020).

Mudau (2013) defined teaching difficulty as a situation where teachers practices failure to create meaningful learning, resolve misconceptions, developing of inquiry as well as problem solving skills and thus influences learner academic performance. According to Du Plessis and Mestry (2019) some under-qualified science teachers only used textbooks to teach science and fail to do practical investigations with learners even if laboratories are readily available at their school to do practical activities. This means that teachers without appropriate knowledge of science might find it difficult to use various methods of instruction and resources available at school to assist in the implementation of science curriculum.

Alebous (2021) report that some of primary teachers hesitate to teach science because of limited subject matter knowledge (SMK) and pedagogical content knowledge (PCK) of science. Noble (2016) reported that primary schools teachers are teaching Natural Sciences though they lack confidence on the subject. Mudau and Nkopodi (2015) show that teachers who have science limited content knowledge (CK) lack confidence and find it difficult to teach science. Additionally, teachers who lack subject matter knowledge (SMK) may avoid teaching other science topics and such can results in learners not having a good foundation of science. Noble (2016) indicates that some teachers did made urgent pleas that they need to be assisted with curriculum delivery in their classrooms. Consequently teachers require subject matter knowledge (SMK) and pedagogical knowledge (PK) so that they can assist learners to receive proper education.

Budiastra, Wicaksono & Erlina indicated that (2020) categorise content knowledge (CK) that teachers should have into four types namely, Common Content Knowledge (CCK) which is a knowledge teacher have in order to teach including terminology, scientific notation and curriculum knowledge; Specialised Content Knowledge (SCK) is a kind of knowledge beyond what is required in the curriculum e.g. teachers must specialize in their subjects in order to explain content beyond the curriculum when arises; Knowledge of Content and Students (KCS) is a knowledge of content and of the learners abilities which assist teachers to assign task that are of learners interest and motivating as well as equivalent to learners cognitive abilities; and Knowledge of Content and Teaching (KCT) is a knowledge which teachers needs to understand the subject and pedagogical issues affecting them e.g. enable teacher to use correct instructional methods according to learners learning methods. The above statement is supported by by Budiastra, Wicaksono & Erlina indicated that (2020) where they reported that teachers who have the content knowledge (CK) are able to use various instructions and assign appropriate activities to their learners at school. Consequently it is imperative for subject teacher to be well-trained because the CK that the teachers have on a subject influences the

aspects of teaching including preparation, planning and the decisions made regarding the content to be taught and learnt.

Resources in the Teaching of Science

Adeniran (2020) report that teaching and learning of science is effective when required resources and facilities are readily available at schools. This means that sufficient textbooks and facilities such as classrooms, laboratories, and libraries are important aspects that lead to enhance effective science teaching and learning at schools. Moreover, textbooks are also important resources that give teachers comfort and convenience of having lessons planned out as well as gaining access to the appropriate knowledge and skills to teach at an appropriate level (Du Plessis and Mestry, 2019). Ngema (2016) indicates that the challenge of shortage of resources at schools is a matter of concern worldwide. Garcia and Weiss (2019) report that even though democracy dawned in 1994 in South Africa, there are still schools in the rural and township areas that lack resources and well-trained qualified sciences teachers. This means that some of the schools which are located in rural areas lack resources to be used to support teaching and learning, such as textbooks and laboratory equipment, which are compounded by a lack of infrastructures.

Adeniran (2020) states that shortage of resources including textbooks, physical infrastructure and laboratory equipment can hinder learners' interest in the subject and also resulted in learners' poor performance. Alebous (2021) reports that teacher find it difficult to teach science in a school that is not well resourced and also lack laboratories. Shortage of resources can also limit written work because teachers cannot give learners home activities as the learners do not have or they are sharing textbooks (Mupa and Chinooneka, 2015). Adeniran (2020) reported that learners had not been provided with sufficient textbooks and that some textbooks were of dubious quality. However, Alebous, (2021) indicates that teachers always mention lack of equipment, insufficient time and big classes as reasons for not conducting practical activities at their schools.

Du Plessis and Mestry (2019) states that limited resources encourage teachers to modify the curriculum by utilising hands-on experiences. Alebous, (2021) report that practical lessons clarify and reinforce scientific concepts. This means that availability of practical activities can develop learner interest and the love for science, improve learner cognitive skills and problem solving skills. Furthermore Juhji & Nuangchalerm (2020) indicated that it is importance for learners to conduct investigations and arrive at conclusions through observation. Alebous, (2021) emphasises the important of sufficient resources by reporting that observations and experimentation activities are essential in teaching and learning of science. Juhji & Nuangchalerm (2020) states that teachers with inadequate resources are encourage to source alternative resources in order to implement scientific investigation and develop problem solving skills to their learners.

Teaching Strategies of Science

According to Strouse, Nyhout & Ganea (2018) teaching and learning activities that involve students' active cognitive participation will create comprehensive teaching and learning. Therefore, the way in which a teacher presented a lesson to the learners determines it effectiveness and the level of understanding by the learners who are being taught. Teaching and learning of NS require both theoretical and practical knowledge. This means that NS promote learning that is active in the classrooms as well as outside the classroom, where learners can engage in authentic learning processes, such as cooperative learning, group work, practical work i.e. investigation, experiment etc. According to Budiastra, Wicaksono & Erlina indicated that (2020) teaching methods contribute to learner academic performance in the science subjects. NS curriculum expect learners to develop cognitive and practical skills such as experimenting, investigating, recording information, analysing and interpreting information as well as asking questions. Hence, it is teacher responsibility to develop and improve some of these skills to their learners during their teaching practices.

Adeniran (2020) reports that teaching methods used by some science teachers reduces science teaching to preparation for examinations and tests rather than enhancing the learner's abilities to explore ideas by means of hands-on activities. Adeniran (2020) further emphasized that science learning is still done by means of parrot learning which results in the subject being uninteresting. Additionally this can leads to failure of learners to relate new knowledge with their prior knowledge because they are likely to memorise concepts without understanding. However, the lecturing methods are used because of teachers being used to such method due to their teaching experiences (Lombaard, 2015). Mupa and Chinooneka (2015) argue that poor teaching methods have a direct influence on the poor performance of learners in the science subjects. Mupa and Chinooka (2015) where they indicates that teachers do not employ several teaching methods and they do not prepare a variety of media for use in the teaching and learning. Mupa and Chinooka (2015) further reported that teachers instructional materials are limited to textbooks and syllabuses and do not go beyond that. Budiastra, Wicaksono & Erlina indicated that (2020) point-out that the teacher is a profession that deals with the provision of education for nations' future generations; thus, teachers must

improve their competence as professional teachers. Therefore from time to time, attend refresher courses presented by different people so as to incorporate different methodologies.

Natural Science teaching that is learner centred can assist learners in developing knowledge and improve skills including identifying problems, doing investigations, interpreting information as well as communicating. Alebous, (2021) indicated that practical work in schools can effectively and strongly support exploration, manipulation and development of concepts and can make the concepts manifest, comprehensible and useful. This means that the methods and resources the teachers decide to employ should be related to the content to be taught so that learners can achieve the desire knowledge and skills. Alebous, (2021) suggested that science should be made practical so that the learners may relate it to their daily situations. Moreover, Alebous, (2021) also recommended that there must be regular seminars to equip the teachers with diverse methods of teaching.

Time Allocated for Natural Sciences teaching

NS is allocated three-hours per week and there are some teachers who are not using their time effectively. The study findings by Mupa and Chinooka (2015) indicated that a small percentage of teachers were on track, but that many teachers still failed to interpret the learning area policy and plan relevantly, which could make the ideal goals set by the Education Department futile. In addition, Mupa and Chinooka (2015) reported that pupils learn in harsh and conducive teaching and learning environments and there is low morale among teachers. Therefore it is very important for teachers to be prepared to actively teach for the minimum number of hours a day, every day as specified by policy.

Mbatha (2016), further reports that with the curriculum overload, teaching in most South African schools is moving too slowly to cover anywhere near the demands of the curriculum. Therefore, teachers needs to be careful when making selection of content, and make use of a variety of approaches to teaching and learning science as stipulated in Curriculum Assessment Policy Statement Natural Sciences Grades 7-9. The NS subject deals with the promotion of scientific literacy by developing and using science process skills in a variety of setting, application of scientific knowledge and understanding and appreciation of the relationship and responsibilities between science, society and the environment. Therefore, teachers must be able to create and design learning environments with atmosphere of prosperity and contributing to the learning targets (Darling-Hammond, Flook, Cook-Harvey, Barron, & Osher, 2019). Research also indicates that NS is so wide; there are many topics to be covered and a lot to do on each topic (Mtsi and Maphosa, 2016). Mtsi and Maphosa (2016) suggested that more time should be allocated for science teaching in the school curriculum to enable adequate coverage of all syllabus requirements including practical work in science. Consequently, teachers need to be punctual, well prepared and have the class ready, as simple starting points in time management.

The Language of Science Teaching

According to Ngema (2016) science requires people to understand concepts and being able to communicate them in writing. Mogashoa (2017) report that it is difficult for learners to understand and conceptualise content taught when they still struggle with the language used in teaching the subject. Nuangchalerm & El Islami (2018) states that science subject expect one to be able to analyse data presented in diagrams and communicate such data in words, and thus to know the theories and apply them. Hence, English which is the medium of instruction has been identified as one of the main barriers to learning science for the majority of South African learners (Prinsloo, Rogers and Harvey, 2018; Mogashoa, 2017). Ngema (2016) observe the problem is worsened if the science teachers are not proficient in English. This means that teacher who lacks proficiency in the medium of instruction results in the learners developing anxiety and a negative attitude towards people who speak the language; in this case it is the teachers. Furthermore, Hlabane (2014) indicates that language has a strong effect on educational quality, especially so in rural and historically black schools in South Africa, which have the problem of giving instructions in English and it affects greatly the quality of education. According to Sethusha (2015), English is used to teach curriculum subjects, which is not a home language in Limpopo Province. Hlabane (2014) state that it is important for the learners to understand English because they are expected to read the texts, analyse and come to conclusions. However, learners can be able to do such if they understand English.

Some science learners have difficulty in understanding the language of instruction which is English. Tshiredo (2013) report that proficiency in the medium of instruction results in good academic performance and Hlabane (2014) disagree with this finding by saying that science is a language on its own and a learner need to be proficient in both science terminology and English the medium of instruction in order to succeed academically. Sethusha (2015) indicates that some teachers sometimes use other official languages to explain certain abstract concepts when they teach, which is referred to as code switching; and teachers felt compelled to do this because learners are not proficient in English. However even if code switching is suggested to assist second language learners, there are also some words that cannot

be expressed which may lead to misinterpretation (Hlabane, 2014). Ngema (2016) suggested that science terms and English should be taught to learners so that they are able to express themselves and are able to analyse scientific information because there is no other way to teach it other than in English in order for them to succeed academically.

Parental Involvement in Science

Most of the teachers indicated that learners are not disciplined and some do not come to school whilst the support from parents is minimal (Mudau, 2013). Furthermore, learners lacked assistance with homework for example because the majority of parents are illiterate and thus not involved in supervision of learners beyond school environment (Sinyosi, 2015). Often the manifestations of non-involvement of parents in the education of the learner reveals among others negative factors of emotional distress, involvement of the child in violence and substance abuse for example (Du Plessis and Mestry, 2019). Ngema (2016) show that parents are unable to assists their children with school activities as well as additional resources because they are uneducated and unemployed. Most parents in the Du Plessis and Mestry (2019) study had attained only primary school level and thus resulted in a learner not receiving any assistance with their homework.

Poverty also played a major role. The majority of households where the learners came from were poor (Du Plessis and Mestry, 2019). The majority of the Learners' parents or guardians had their household income sources from primary informal agriculture which generated very little disposable income (Sahin, 2019). Parents serve as role models and guide in encouraging their children to pursue high educational goals and desires (Sahin, 2019). Du Plessis and Mestry, (2019) supported this assertion and indicated also that those learners whose parents are not adequately literate are disadvantaged because in modern education parents are required to assist children with their assignments and projects from the home. Some of these parents, although they had attained Grade 12 level of education could not assist the learners because they too lacked appropriate knowledge of the subject (Sinyosi, 2015). The study found that the majority of parents had attained educational levels less than Grade 12 income (Sinyosi, 2015).

Effective teaching and learning in school can only take place if the teacher, learner and parent involve themselves in the process, especially the parent, who is the main investor in the process (Sahin, 2019). Finding from a study conducted by Du Plessis and Mestry (2019) revealed that some parents are not able to assist their children with school activities and additional resources because they are uneducated and unemployed. These results in learners being unable to be not assisted by their parents nor can their parents afford tutors to assist their learners with extra lessons when they struggle (Ngema, 2016). Parents also do not participate actively in school matters. This limitation of parental involvement has a negative effect on a learner's education (Ngema, 2016). Consequently it is imperative for parents to be engaged in education of their children to improve children's performance.

Conceptual Framework

The study adopted classroom practices diagnostic framework (CPDF) by Mudau (2013) which theory offers an explanation on how teachers' knowledge and instructional strategies succeed interaction and discourse during teachers classroom practices. Teachers' knowledge and instructional strategies can be facilitated through teacher classroom practices. During classroom practices the teacher can display his/her knowledge of the curriculum understanding and learners preconceptions. The teacher can use his/her knowledge in determining instructional strategies to be used in a particular content of a lesson. The instructional strategies that the teachers decide on can result in interaction and discourse between the teacher and learners, between learners as well as between learners and the content taught. Therefore, teacher knowledge and instructional strategies are ideal for this study as they can promote interaction and discourse among the target group, i.e. teacher, learners. This takes place in the active learning environment. Moreover, challenges teachers experiences can be diagnosed appropriately in their classroom practices. Consequently, classroom practice diagnostic framework (figure 1) explored challenges teachers experiences in Natural Science classroom.

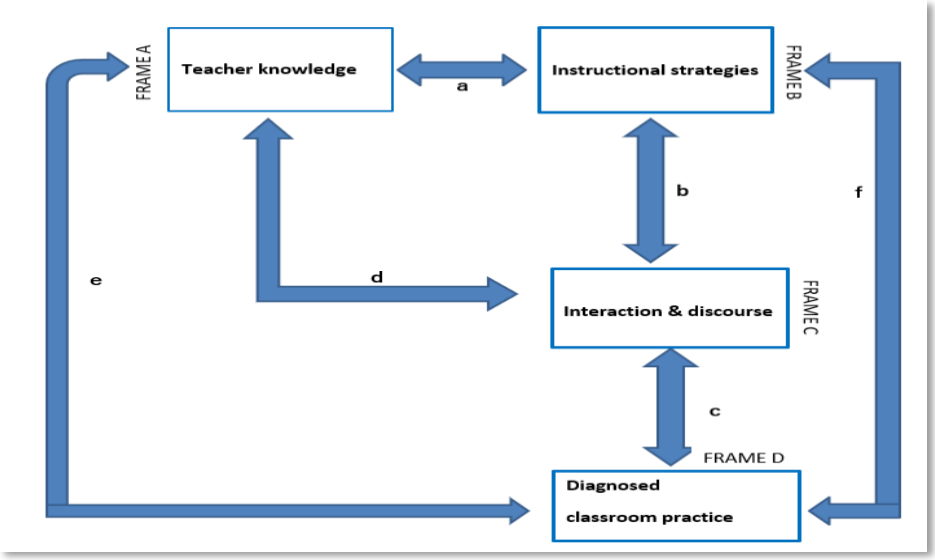


Figure 1.
Classroom Practice Diagnostic Framework (CPDF)

Problem of Research

The problem of this study was developed by one of researchers' anecdotal experiences. The hard work of the government of South Africa in producing qualified science teachers in rural areas such as in the Limpopo Province was noted. However, it was observed that there are still schools situated in rural areas with minimal or no teachers who specialise in Natural Science. It was evident that such teachers experience challenges when teaching the subject (Nkanyani, 2018). As a result, this paper explored some of the challenges teachers' experiences in the teaching and learning of Natural Science. The following research question guided the study, what are the teachers' view about the teaching and learning of natural sciences?

Method

Research Design

The main purpose of this paper was to explore the challenges teachers' experiences in the teaching of senior phase natural sciences at schools. For the purpose of this study, a qualitative research design was employed to provide rich descriptions of phenomena under exploration. Qualitative approach enable researcher to focus on actions performed, including reading and listening to words in all of their complexity as they occur in a natural setting or in a real context (Nieuwenhuis, 2016c). Qualitative case study was adopted as an educational style for this research. The study targeted Natural Science teachers from the Vhembe District, Limpopo province. This research used interpretative qualitative case study in an attempt to develop a full understanding on the challenges teachers' experiences when teaching Natural Science in the Senior Phase. The research sites for this study were rural schools under Makhado Local Municipality in the Vhembe District in Limpopo province. These sites were chosen for the study as they were public schools that offer Senior Phase Natural Science. The locality of Makhado Municipality can be seen on Figure 2.

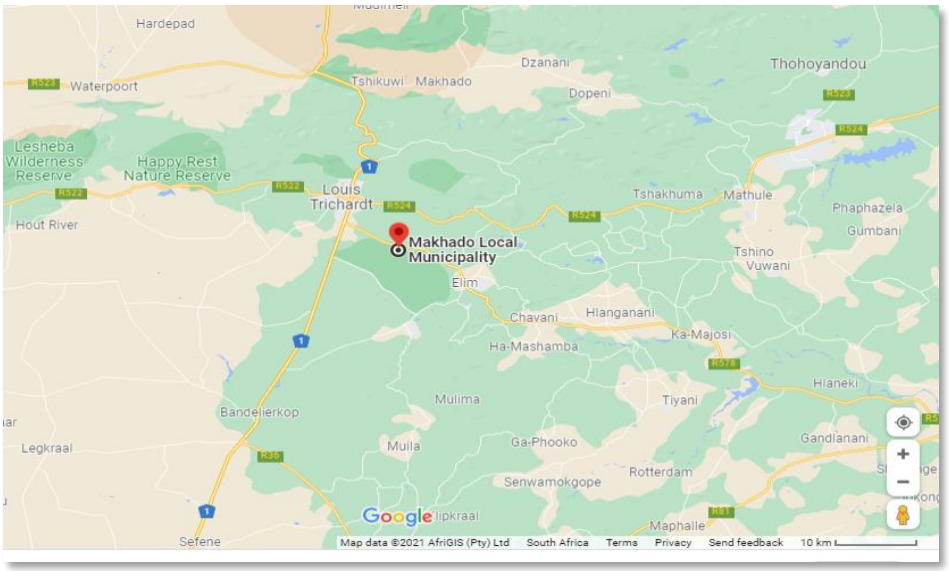


Figure 2.

Map Showing the Location of Makhado Local Municipality

Sample

The sample of the study consisted of two Natural Science teachers, i.e. two primary teachers and one secondary school teacher from the Vhembe District, Limpopo province. In this study, purposeful sampling was used because it enables the researcher not to spend more time gathering data from participants. In short, the researcher was favoured in terms of time. By using a purposeful sampling, the researcher managed to include two participants (cases) according to relevant criteria, i.e. teachers offering senior phase Natural Sciences at Vhembe District schools. Purposive sampling in qualitative research includes identifying and selecting participants that have experiences and knowledge about phenomena of interest (Annan, Adarkwah, Abaka-Yawson, Sarpong & Santiago, 2019). Hence, the selected teachers assisted the researcher in answering research questions and achieving the study aim. Therefore, it was not necessary to collect data from each rural public school in Vhembe District in order to acquire valid findings.

Participants

The total of two teachers participated in the study, one female and two males. The name of participants and schools used in this paper are pseudonyms and this was done to protect the identity of the participants. Two teachers were teaching senior phase at primary schools whereas one teacher was teaching senior phase at secondary school. Moreover, the teachers comprises of different qualifications and experiences. The table 1 below shows the demographic details of the two teachers:

Table 1.

Demographic Details of Teachers

Teacher and school pseudonyms	Gender	Qualification/s	Teaching experience in years	Number of years teaching natural science	Type of school
P1/J/F/SPS (Superiority primary school)	Female	Senior Teacher Diploma (Mathematics, Biology, English, Afrikaans)	16	13	Public school
P2/C/M/PSS (Presented secondary school)	Male	Higher Education Diploma (Mathematics, Chemistry and Physics)	18	15	Public school

Data Collection Tools

Observation

Observation is a systematic process of recording the behavioural patterns of participants, objects and occurrences without necessarily questioning or communicating with them (Budiastra, Wicaksono & Erlina, 2020). Observational tool was used to collect data during teacher classroom practices of natural sciences and the entire lesson was video-recorded to ensure accuracy of the data collected. Researcher obtained teachers' consent prior to lesson observation in order to ensure reliability and to avoid mistake of data collected during the process of analyzing data. The researcher

learns and observed participants in their classroom setting without taking part in any of the activities conducted in the lesson. The researcher transcribed the video-recorded lesson into the word document. Lesson observation supplied the researcher with information of what was actually happening in Natural Science classroom. However as far as teaching is concerned, only two lesson observations from each teacher was sufficient for the researcher to examine the challenges teachers experiences in NS classroom.

Interview

Data of this paper also obtained through the use of semi-structured interview. Semi-structured interview is a method used in qualitative research which researcher has an opportunity to prepare interview questions before conducting an interview with interviewees but ask open-ended questions which allow for discussions with the interviewee (Doyle, 2019). In this study, researcher conducted direct interview with the teachers where semi-structured interview form and audio-recorder was used in data collection. Interview tool was used to collect data based on teacher knowledge, instructional strategies as well as resources available to support teaching and learning at school. The audio recorder captured the data throughout the interview process and teachers asked the same open-ended questions.

Internal Validity

Internal validity is a way of making sure that the reader believes or is convinced by the findings of the research process (Korstjens & Moser, 2018). Pilot study was conducted with one senior phase natural sciences teacher who was not part of the main study where proposed instruments, i.e. observational tool and semi-structured interview tool was tested to ensure validity of this paper. Moreover, the researcher develop data analysis scheme (DAS) and implemented it in the pilot study. Additionally, the researcher increase study validity by focusing only on the data provided by the participants of the study.

Data Analysis

In this study, the two cases were analysed and interpreted separately. The researcher transcribed Video-recorded lesson and audio-recorded semi-structured interview of each case verbatim to word document. Thereafter, researcher replayed Video-recorded lesson and audio-recorded semi-structured interview of each case to verify if the words transcribed correspond with what was on the recording devices. However, grammatical errors displayed by participants were not corrected to ensure that the data gathered was presented accordingly and does not lose its meaning. McMillan and Schumacher (2014) report that inductive analysis is a process in which qualitative researchers synthesise and extract meaning from the data by deriving categories and patterns from specific data. Additionally, McMillan and Schumacher (2014) presented phases of qualitative data including(a) data organization; (b) data immersion; (c) generating categories and themes; (d) data coding; (e) offering interpretations through analytic memos; (f) searching for alternative understanding; and (g) writing of the report.

Results

The findings of this study obtained from the classroom practices of two cases. The cases were presented separately as this was not a comparative study. The study focus was to identify and understand some of the challenges each teacher experiences in natural sciences classroom practices. The researcher used codes to present cases of the participants:

Participant 1/P1/J/F/SPS/female/ Superiority primary school= ***P1/J/F/SPS***

Participant 2/P2/C/M/PSS/Male/ Presented secondary school = ***P2/C/M/PSS***

Themes proposed for study are as follows: Understanding teacher knowledge on content and context within Natural sciences curriculum, understanding teachers' instructional strategies within natural sciences curriculum

Case 1: Participant 1/P1/J/F/SPS/female/ Superiority Primary School= P1/J/F/SPS

Theme 1. Understanding Teacher Knowledge on Content and Context within Natural Sciences (NS) Curriculum

For the purpose of this paper, the researcher had to ask the teacher what she was going to teach and what learners' prior knowledge will be required in the learning of the content to be taught. During the interview process, the researcher noted that the teacher had an idea of what she was going to teach as she was able to give the lesson topic as well as the learners' prior knowledge needed in the topic to be taught. She indicated that she would teach about the separation of mixtures and such a topic falls under the knowledge strand of matter and material. During interview process she mentioned that:

***P1/J/F/SPS**: I'm going to teach separation of mixtures.*
***P1/J/F/SPS:** The prior knowledge that they must have it must be from their previous class grade 4, 5, 6 more especially in grade 6, then is where they have acquired the first knowledge that when we put 1 and 2 together they are now a mixture.*

During lesson observations researcher observed that the teacher did teach natural sciences, this was evident during lesson observation that took place in a classroom environment when she presented a lesson about separation of mixtures. During classroom practice, she taught about how to separate mixtures and methods of separating mixtures. When she taught about methods of separation mixtures she even demonstrated the methods. This was evident in the statement captured from classroom lesson observation below:

***P1/J/F/SPS:** You have put things together **(she put books together to make a mixture-see picture below),** what is to separate? I have made a mixture (Initiation, concept, Subject Matter Knowledge)*

mixture of books on Jane's hands

Learner: *taking things out and put them in their order (the teacher repeated the response)*
***P1/J/F/SPS:** My mother has boys and girls, we were using one rondavel being five at home, then my father build a 12 rooms house (learners whispering) then my mother try to separate us, how can she do that? (SMK, SI)*
***Learner 1 (L1):** my mother will take three boys to their room and two girls will share their room (response).*
***Learner 2 (L2):** each one of us get his or her own room (response).*

P1/J/F/SPS used different coloured chalks as visual aid to illustrate method of separation called hands sorting. See pictures below:

a) Coloured chalks

b) hand-sorting method

P1/J/F/SPS had maize meal, samp, beans and sieve as visual aid to illustrate method of separation called sieving. See picture below

a) Maize meal b) Samp c) beans d) sieve

***P1/J/F/SPS:** we want to see someone sieving, who can do that for us? (SI, demonstration, see picture below)*

Learner sieving

The researcher had to inquire further on learner socio-economic background and challenges that the teacher encountered in the teaching and learning of natural sciences. Based on the findings, learners have poor background as they depend on social grants. Teacher encountered numerous challenges in the teaching and learning of NS including insufficient resources, no laboratory, English instruction, insufficient time for teaching and learning, lack of parental support, lack of teachers as well as insufficient workshops. These challenges could result in learners not receiving proper education. During interview she indicated that:

P1/J/F/SPS: *Oh that one is challenging. Most of the parents depend on grants. Then you see that children do not have enough resources. For example others they come bare-footed at school, others you see that they are coming without eaten anything they are only waiting for the break that they will eat at school. And the other challenge is that most of the learners they stay with their grandparents at home who are illiterate. They are not being assisted; you gave them the task they come back without doing it. Why? Because there is no one who is behind them at home.*

P1/J/F/SPS: *You know we are at far, far, far rural areas. The challenges that we are facing is the language barrier and the second one is the resources. We don't have for example as you can see there is no laboratory here. The other thing is there are no laboratories to conduct the experiment, we don't have the apparatus here around us, and you have to search for ourselves and some materials that are useful we don't have. For example if I want a litmus paper where will I get it, even the school is failing to buy, the government failing to provide then that is the serious challenge that we are facing.*

P1/J/F/SPS*: Most of the concepts need more time to can cover. For example, the terminologies it need time because learners have to use dictionary. Can you see now we are going for a language, they have to use to check the word from the dictionary. They have to go for the key words, it takes time. Again we need to conduct experiment, it also need time. When you have a 30 minutes period you squeeze your lesson to be short, you shorten learners mind, because you can't give them everything at 30 minutes. Can you see, we cannot conduct a proper experiment with the proper result using little six hours per week*

P1/J/F/SPS*: Yes let me give. You know NS subject is too demanding, where it needs more workshops that can be conducted before, before the term. The problem that we are facing is that you find that the department is bringing the workshops at the middle of the term or at the end of the term. Now they have introduced the pace setters oh no not the pace setters I am referring to trackers, the planner and tracker they are bringing it very late when you have already pushed the content. Then I think we need more workshops. It also need team work, Natural Sciences need team work. Why? Because not all the strands are easily for the teacher to carry. If we can share the subject, then the problem is that we don't have enough teachers or enough educators at school, you find that such a person have to carry the whole of the subject.*

Theme 2. Understanding Teachers' Instructional Strategies within Natural Sciences Curriculum

The teachers play an important role in ensuring that learners understand the content taught in their learning environment. As a result, the researcher had to find out the instructional strategies used by a teacher during natural science lesson. The teacher revealed different methods she use when teaching Natural sciences. This was supported by statement from interview below:

P1/J/F/SPS*: I use different methods. When we teach Natural Sciences we use demonstrations, we use a…it might be interview, we also use this one that we are doing now, we interview to check learners, question and answer method, identifying, illustration, discussion, group work these are the methods that we use.*

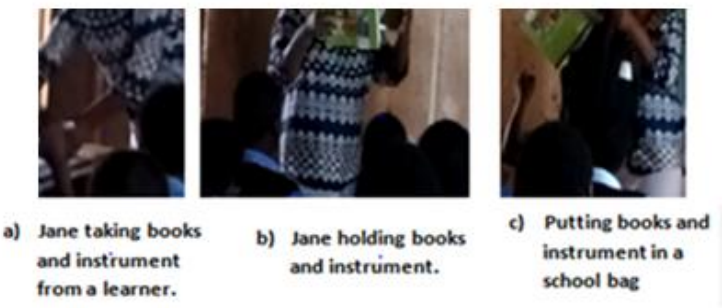
During the lesson observation process, researcher noted that teaching strategies the teacher used includes, question and answer, lecturing, demonstration; illustration, modelling. Additionally, learners were given class work and homework. Learners were asked to explain the mixture and give examples of mixtures. Most of the learners raise their hands as an indication of being able to recall what they learnt in the previous grade. The learners gave the correct answers. This was supported by statements from lesson observation below:

P1/J/F/SPS: *What can you say when you define a mixture?*
Learner 1 (L1): *is objects that are mixed together.*
P1/J/F/SPS: *can you give me the examples, what is it that you can mix together?*
Learner 2 (L2): *sugar and water*
Learner 3 (L3): *cement and sand*

P1/J/F/SPS used the lecture method to explain what a mixture is and how the substances are put together to form a mixture in order to make learners understand the concepts. P1/J/F/SPS also used both the lecture and demonstration methods when explaining how substances are put together to form a mixture In addition, she makes use of the demonstration method using examples for learners to gain a better understanding of the concept.

P1/J/F/SPS: *a mixture is when two or more substances are put together. When we say two or more substance is put together we find these substances are put together in a physical way. The way that you can see, and the way that you can see physically* (lecture method used to make learners understand the concepts).

P1/J/F/SPS: *you see someone taking an instrument and the books putting inside the school bag that is a mixture* (example-demonstration methods. See pictures below (a-c)



During interview P1/J/F/SPS indicated that she used modelling when showing substances to be mixed to form a mixture and she used illustration with examples from the textbook. She also uses examples when explaining separation of mixtures.

P1/J/F/SPS: *I use modelling, under modelling I was showing the substances that we are going to mix and then after they have been put together which is a mixture.*

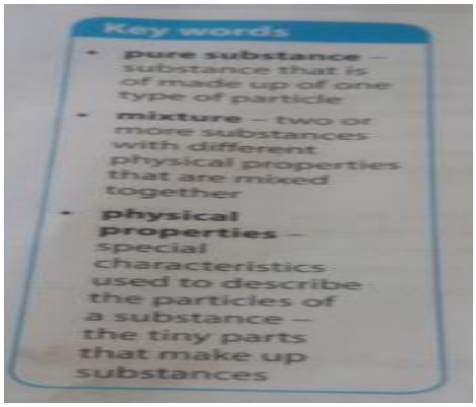
P1/J/F/SPS had rice, beans and salt as visual aid to demonstrate a mixture. See pictures below

P1/J/F/SPS formed a mixture by means of putting rice, salt and beans together and she gave the learners an opportunity to separate the mixture.

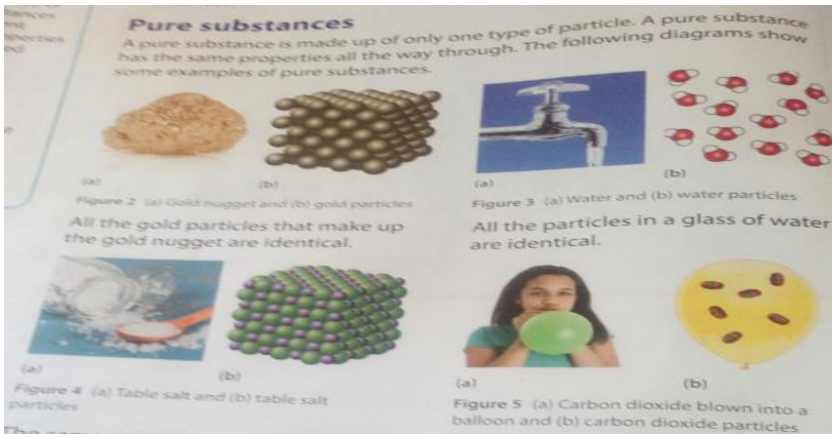
a)mixture

b) learners separating the mixture

The study also revealed that the teacher make use ***illustration with examples written from platinum NS textbook to teach the content to the learners.*** Learners were told to open page 80 on their platinum grade 7 Natural Sciences textbook. Thereafter she asked learners questions. See pictures A and B below.



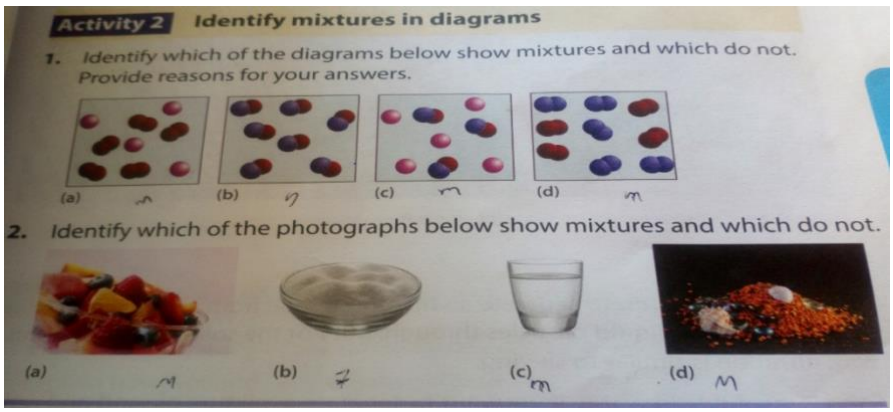
A) Key words

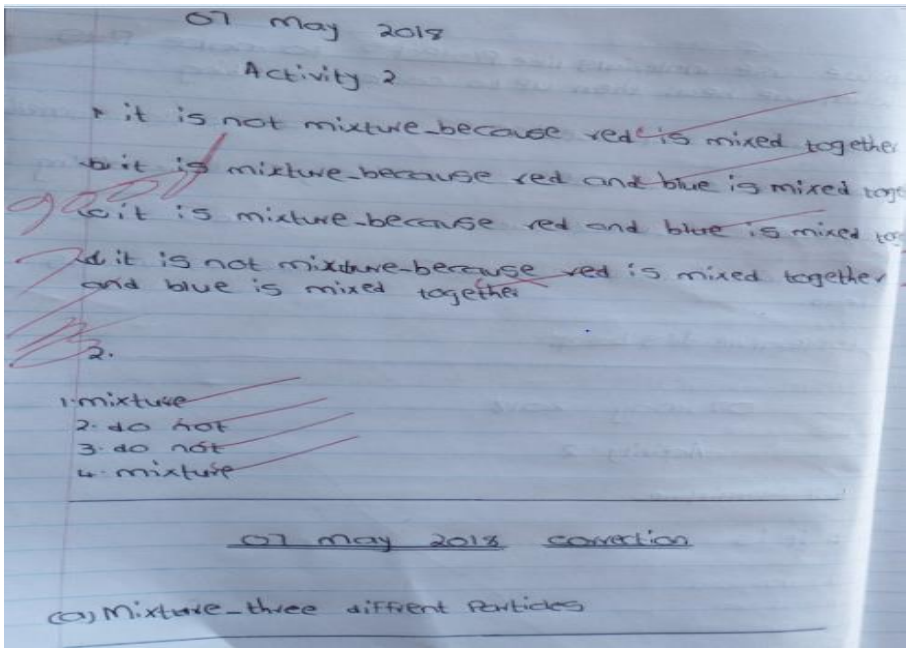


B) Examples of pure substances

P1/J/F/SPS: *there are key words there, number 1 what is written there* (picture A above)? (Initiation, authoritative)
Learner 1 (L1): pure substance (response)
P1/J/F/SPS: *what does it mean?*
Learner 2 (L2): *substance that is made up of one type of particle.*
P1/J/F/SPS: can you give me the example of a substance that is made of one particle (SI)
Learner 3 (L3): water (response)
Learner 4 (L4): milk (PK, not shown on picture B above)
Learner 5 (L5): salt (response)
P1/J/F/SPS: No, no, salt there are some particles there (Authoritative-convey information)
Learner 6 (L6): gold (response)
P1/J/F/SPS: *can you point where you find it?* (Learners pointed at their textbook picture B above)
Learner: *gold particles* (response)
P1/J/F/SPS: *Water particles, where are water particles?* (Learners pointed at their textbooks, see picture B above)

During the lesson it was noted that learners wrote and marked the classwork. The two pictures below show classwork given to learn and the marked classwork.





Case 2: ***Participant 2/P2/C/M/PSS/Male/ Presented secondary school = P2/C/M/PSS***

Theme 1. Understanding Teacher Knowledge on Content and Context within Natural Sciences Curriculum
During the interview process, the researcher asked the teacher what he was going to teach and the resources he intend to use. He indicated states of matter and the arrangement of particles as his lesson topic which fall under the knowledge strand of matter and materials. He further indicated chalkboard and textbook as his resources for the lesson.

Researcher (R)*: What are you going to teach today?*
P2/C/M/PSS*: State of matter and arrangement of particles*

The teacher displayed adequate content knowledge when he explained three states of matter in terms of their arrangement, movement, and spacing using the particle model of matter. This is evident in the statement stated during lesson observation below:

P2/C/M/PSS*: The arrangement of particles of solid, liquid and gas. The arrangement of particles solid or ice are arrange in specific pattern. Liquid are loosely arranged and are not in a fixed shape. Gas or steam they are not arranged in a specific pattern. Movement of particles; under ice they vibrate in a fixed position, water they move more freely than in solid and slide pass each other, and steam move randomly in all the direction and fill the whole container the space between the particles particles of ice are closely paired. The space between water is large and space between steam are very large.*

The researcher had to inquire further on the challenges the teacher encountered when teaching natural science. Based on study findings, the teacher encountered numerous challenges including insufficient teaching materials as he indicated that only textbook and chalkboard are materials available to support his teaching. He further indicated that he attended workshops where he attain knowledge he did not know which was a challenge to him. It was noted that

the teacher sometimes responded interviews questions using his home language which is Tshivenda. During interview process he stated that:

***P2/C/M/PSS**: Ndi ya ndi tshi athenda dzi workshop dza science ndi hone hune ndavha ndi khou tangana na zwithu zwiswa zwine nda sa zwi divhe zwine kha nne zwavha zwi challenge. Kha workshop ri vha ri khou ainiwa zwithu zwine ri si zwi divhe*

The teacher pointed out that learners were coming from poor background and they are depending on social grants. The other challenges teacher stated was that learners understanding have been delay as there were no experiments for lesson demonstration. This is evident in the statement from the interview below:

***R:** Which factor do you think delays learner understanding?*
***P2/C/M/PSS:** Ndi ngauri a hu na zwi experiment zwa u demonstrator lesson heyi.*

The teacher indicated that the time allocated for natural sciences teaching and learning was not sufficient as it requires learners to conduct experiment, investigation and project which requires more time. This was evident in the statement from interview below:

***R:** Do you think the time allocated for Natural Sciences teaching is sufficient to complete or cover the intended curriculum?*
***P2/C/M/PSS:** No.*
***R:** Why are you saying no?*
***P2/C/M/PSS:** Ndi ngauri science I toda tshifhinga tshilapfu ngauri huvha hu na zwi experiment, investigation na dzi projects lune zwi toda u na tshifhinga tshilapfu. Ri lilela u tavhanya u fhedza syllabus ngeno vhana vha khou salela murahu.*

Theme 2. Understanding Teachers' Instructional Strategies within Natural Sciences Curriculum

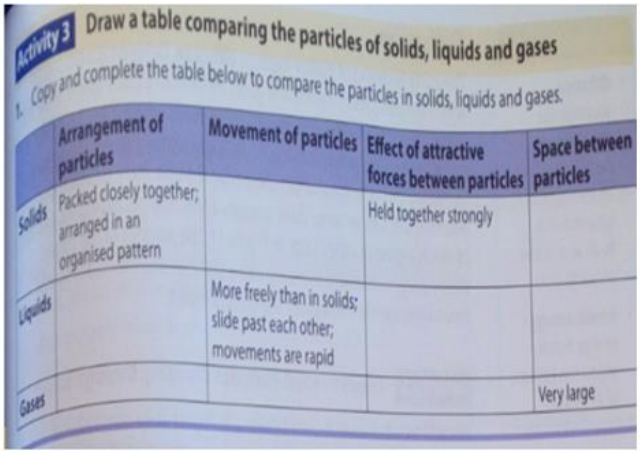
The researcher had to find out more on the instructional strategies that the teacher used in the teaching and learning of natural sciences curriculum. It was noted that the teacher used questioning strategy that requires learners' prior knowledge at the beginning of the lesson. Examples of questions that the teacher initiated in order to engage and evaluate learners at the beginning of the lesson are as follows:

P2/C/M/PSS: what is matter?
Learner: *model that helps us understand that matter is made from particles and how they affect the behaviour of matter (misconception).*
Learner: *matter is that occupies space and has mass.*
***P2/C/M/PSS**: matter is anything that occupies space and has mass. Mention three state of matter.*
Learner 1 (L1): *solid.*
Learner 2 (L2): *liquid*
Learner 3 (L3): *gas*

P2/C/M/PSS *used Tshivenda to explain sublimation process using example. He indicated that:*

***P2/C/M/PSS**: When ice turns to gas which is vapour it is called sublimation. Naya checkers hangei ho no rengiswa dzi khovhe ni do wana murahurahu hangei khovhe dzedzi dzi nobva madini ni wana dzo vhewa kha inwe ice mara nga ngomu ni tshi sedza a ninga do vhuya na wana huna madi kha hedzila ice, ri khou wanana ne ni do wana hu khou sokou bva vhunwe vhutsi so hu khou vha na evaporation ri khou wanana ne and learners said yes. heyo dry ice a i turn ubva kha ice ya ita water, I turner ubva kha ice yavha vapour.ndi hafho i no vhudziwa upfi sublimation*

The teacher gave learners class activity which was from platinum grade 8 Natural science, see picture below:



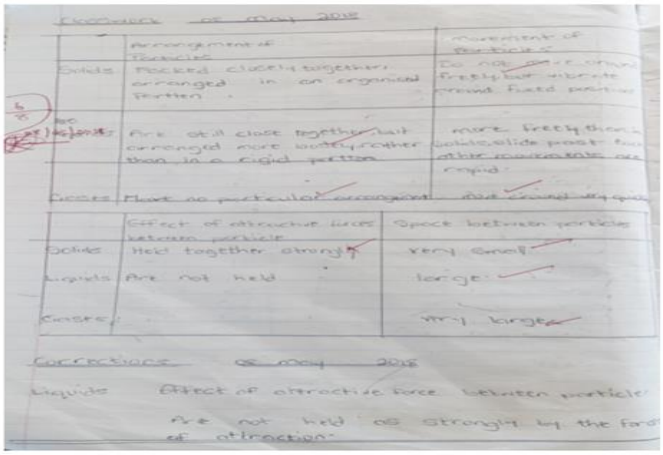
Activity 3 Draw a table comparing the particles of solids, liquids and gases

1. Copy and complete the table below to compare the particles in solids, liquids and gases.

	Arrangement of particles	Movement of particles	Effect of attractive forces between particles	Space between particles
Solids	Packed closely together; arranged in an organised pattern		Held together strongly	
Liquids		More freely than in solids; slide past each other; movements are rapid		
Gases				Very large

.

The picture below shows class activity marked:



Discussion

The study conducted by Budiastra, Erlina & Wicaksono (2019a) reported that there are still large numbers of unqualified teachers who teach science at schools. The above statement is supported by the study findings which revealed that teachers participated in the study acquire different teaching qualifications and none of them majored in Natural Science (NS). **P1/J/F/SPS** holds a teaching qualification of Senior Primary Teacher Diploma where she specialised in Mathematics, Biology, English, Afrikaans and Bed Hons.in management. **P2/C/M/PSS** holds a qualification of Higher education diploma majoring in physical sciences and mathematics. This means that lack of science teachers is a reality that exists in many schools. The study found that insufficient resources and unavailability of laboratories are the main challenges that NS teachers experienced during their teaching practices. **P1/J/F/SPS** indicated that school lack resources and no laboratory for conducting experiment as well as apparatus. This is similar to **P2/C/M/PSS** as he mentioned that only textbook textbooks and chalkboard are available to support teaching and learning. According to Alebous (2021) teachers always mention lack of equipment, insufficient time and big classes as reasons for not conducting practical activities at their schools. However, Juhji & Nuangchalerm (2020) indicated that it is importance for learners to conduct investigations and arrive at conclusions through observation. The above statement is supported by the findings of this study, even though the schools have insufficient resources **P1/J/F/SPS** improvise materials that assisted learners to understand the content taught without difficulties. Additionally, besides the textbook **P1/J/F/SPS** provided at her school she also prepared other teaching aids to assist learners to learn and understand the concepts better. Alebous (2021) emphasises the important of sufficient resources by reporting that observations and experimentation activities are essential in teaching and learning of science. This means that laboratories and necessary equipment to carry out practical activities must be readily available at schools.

The study find that learners are from poor family background and that negatively affected the teaching and learning of science. The data obtained revealed that most learners depend on social grants and some learners go to school without shoes and empty stomach. Therefore such situation negatively affected learning as learners cannot participate fully with empty stomach. The above statement is supported by **P1/J/F/SPS** as she indicated that most of the learners

depend on social grants and they are not well resourced. **P2/C/M/PSS** reported background of learners was poor as they depend on grants. The study also revealed that teachers are using their teaching experiences to teach Natural Science because of shortage of teachers at their school. The study further indicated that English as medium of instruction has an impacts in teaching and learning of science. **P1/J/F/SPS** point out that learners are not fluent in English and they find it difficult to learn the concepts, which results in the teacher being slower when teaching so that all learners can be accommodated. Research by Mogashoa (2017) indicates that it is difficult for learners to understand and conceptualise content taught when they still struggle with the language used in teaching the subject. Additionally Ngema (2016) observe the problem is worsened if the science teachers are not proficient in English. Participants of the study also revealed that time allocated for teaching and learning of science is not enough to cover the content to be taught. **P1/J/F/SP** indicated that the time for teaching and learning natural sciences was Insufficient which results in other content not being covered. **P2/C/M/PSS** mentioned that the time allocated for natural sciences was not enough because there are activities like experiments, investigations and projects that need to be done and such activities require more time. It is clear from the above statement that science teachers have a big load of work to do science by its nature requires a lot of time because teachers have to also give extra lessons to learners as there is little time allocated for this subject and they also have to prepare for practical investigations.

Another finding highlighted by the study is that parents are unable to support their children with additional resources as well as their school work because they are illiterate and depend on social grants. **P1/J/F/SP** indicated that most of the parents are illiterate which results in learners not being assisted with their schoolwork. This finding is consistent with results of researchers like Ngema (2016); Chinyoka & Naidu (2014) which show that some parents are not able to assist their children with school activities and additional resources because they are uneducated and unemployed. The finding of the study also revealed that the workshop conducted is not sufficient since it is once per term. **P1/J/F/SP** pointed out that natural science is too demanding and it requires more workshops.

Conclusion and Recommendations

The purpose of this study was to examine challenges in the teaching and learning of senior phase natural science. Even though this is not a comparative study, one can infer from the results and discussions herein that teachers under study for this paper mainly face challenges which are almost the same. Some of the challenges in the teaching and learning of science including lack of facilities and resources are so fundamental that lead to a failure to enhance effective teaching and learning at school.

The findings of this study provide evidence that there are multiplicity of challenges in the teaching and learning of NS and the following is recommended:

- Basic infrastructure and appropriate resources such as teaching material and lab equipment should be made available in rural schools in order for teaching and learning to be effective.
- Qualified and well trained science teachers must be available in rural schools.
- NS should be allocated more time so that teachers can be able to cover the required syllabus including hand on activities.
- Subject advisors should see that more than one workshop conducted per term to improve teachers' classroom practices.
- The departmental meetings at schools should be taken into consideration as it can assist both HOD's and subject teachers to share ideas on the NS subject, resolve NS contemporary issues and seek assistance where necessary.
- NS teachers should work as a team in order to assist each other to make NS teaching and learning more effective.
- Parents and teachers should work together to improve learners education.

Limitations of the Study

The study focused on two Natural Sciences teachers from Vhembe District in the Limpopo Province. One teacher was teaching grade 7, and the other teacher was teaching grade 8. The fact that the study only focused on two teachers in the Vhembe district may be viewed as a limitation of the study, however through the rich description provided during analysis of data the finding may be applicable to other districts with similar contexts.

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Research Article

Enhancing student giftedness in open distance e-learning through quality assurance using Donabedian steps

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Abstract

Students must have faith in open distance e-learning institutions' quality assurance methods if they are to have faith in them. The article looks into quality assurance and uses a qualitative approach to grasp the concept. To acquire information, a literature review was used. The discourse and practices about systematic quality assurance in open distance e-learning institutions during the Covid-19 pandemic had institutions panic throughout the world, resulting in market-based models associated with neoliberalism's ideology and policy and expressed in economic rationalities such as new public management, total quality management, public choice, and human capital to a large extent. Quality assurance in open distance e-learning aims to preserve and improve educational quality. In order to evaluate open distance e-learning, quality expectations and criteria must be made clear and public. Quality assurance is critical when it comes to open distance e-learning. The process of analysing, assessing, monitoring, ensuring, maintaining, and improving the quality of higher education systems and programs should be ongoing. As a result, relevant technologies can be utilized as pointers in undertaking quality assurance in open distance e-learning settings by relying on Donabedian processes.

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Introduction[2]

Tortop (2021) found that the main problem in training activities, especially in training focused on talent development, is to meet the talent need. This situation can push institutions to take some important decisions. These decisions are the group that is the driving force that should not be lost in education. After the pandemic, the main focus should be on the sustainability of education. It is clear that more practice and research will be needed in areas such as young scientists' training and talent training, new learning software, and individual mentoring. In support of Tortop (2021); Rahiminia, Yazdani, and Rahiminia (2021) believe that programs related to the talented in universities must identify all the talented and abilities of individuals and try empowering them, which requires comprehensive planning. In this paper quality assurance is one of the programs that can be used to enhance the talent and the abilities of students in their learning.

For stakeholders to have faith in quality assurances systems in open distance e-learning, the emphases must be on "Enhancing student giftedness in open distance e-learning through quality assurance using Donabedian steps". According to Buenestado, Fernández, lvarez-Castillo, González-González, and Espino-Daz (2019, p. 4), the notion of quality can be traced back to industry and business in the twentieth century, when issues of quality inspection, control, and assurance became significant in mechanisation. Edward Deming, Joseph Juran, and Phillip Crosby were quality pioneers in their areas, and many of their efforts have ramifications for higher education's Open Distance E-

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[2] In this paper the words steps, phases and process will be used interchangeably.

Learning environment. In the 1980s and 1990s, the United States and Europe were the first to formally incorporate quality assurance (QA) into higher education, with momentum growing exponentially and many other developed and developing countries following suit. The World Bank, the United Nations Educational, Scientific and Cultural Organization (UNESCO), the Organisation for Economic Co-operation and Development (OECD), the International Network for Quality Assurance Agencies in Higher Education (INQAAHE), regional organizations, and professional associations all played a key role in the introduction and spread of formal quality assurance in higher education (Moopen distance e-learningey, 2019, p. 1).

Quality assurance is widely acknowledged as essential for higher education institution to become more efficient, effective, and need-oriented. This has been exacerbated by a growing public and political desire for open distance e-learning institutions to be held answerable for their expected contributions to local, national, and global development. Some people gain power as a result of quality methods, while others lose it. Through the creation of minimum-quality standards, their monitoring, and the resulting centralization of information, these methods assist quality assurers in developing clearer lines of responsibility (according to a top-down logic) through the definition of minimum-quality standards and their monitoring and the consequent centralization of information. In this approach, Quality assurance can function as an internal government instrument, directing higher education in terms of resource allocation and organizational effort. As a result, the implementation of quality assurance regimes necessitates the development of new management abilities and expertise, which are critical for managing distance education e-learning in quality assurance procedures. By entrusting quality assurance process management only to academics, who have long viewed them as a series of operations that "distract from the main activity of teaching and research," the risk is that QA processes become purely administrative (Agasisti, Barbato, Dal Molin & Turri, 2019, p. 962).

Figure 1.
Donabedian Phases/Steps [Structure-Process-Outcome]

These are the phases or steps that quality assurance must follow to enhance student giftedness in Open Distance E-Learning through Quality Assurance. Ameh et al. (2017) found that the model is most often represented by a chain of three boxes containing structure, process, and outcome connected by unidirectional arrows in that order. These boxes represent three types of information that may be collected in order to draw inferences about quality of assurance in a given system.

It is critical to rely on Donabedian steps when performing quality assurance. In the open distance e-learning setting, structure refers to variables that influence the context, such as fiscal resources, academic content, and human resources (Botma & Labuschagne, 2019, pp. 364-365). Examples of structure**:** Human resources, physical resources, organizational characteristics staff training. The term "process" relates to what is being done, specifically the execution of open distance e-learning education programs. Our criterion should be whether or not the teaching and learning activities allow for the realization of all of the underlying theories (Ibid, 2019, p. 367). Examples of process: The sum of all actions that make up the institution; Donabedian process is nearly equivalent to the measurement of quality assurance because process contains all acts of education delivery. Similarly, an outcome must represent the expected positive or negative change because of QA program implementation (Ibid, 2019, p. 368). Examples of outcome: Behavior, or knowledge as well as student satisfaction related to quality of programs of education. Outcomes are the most important indicators of quality because improving student performance.

As a result, quality assurors in open distance e-learning as assessors are expected to participate in scheduled teaching and learning activities, assemble evidence that satisfies the outcomes, and judge whether students have met the program's purpose. To understand quality assurance using Donabedian procedures, we must first understand the structure, technique, and expected outputs.

Problem of Research

Despite the fact that quality assurance, and enhancement are typically complex and difficult, students want reliable information on educational quality in order to make informed decisions about which courses to pursue. Furthermore, academics and university administrators require data to monitor and enhance their courses and programs.

In the paper the following question is asked: How can we enhance student giftedness in Open Distance e-Learning through quality assurance using Donabedian Steps?

Sub-problem 1. *How is accountability in open distance e-learning done?*

Sub-problem 2. How is quality assurance as a principle used in open distance e-learning?
Sub-problem 3. What are quality pointers in quality assurance?

Method

Research Model

This research used a qualitative approach to reconsider the concept of quality assurance in the context of open distance e-learning. Literature reviews were used to gather data. The interpretivist paradigm and contingency theory were used to examine the concept of quality assurance in open distance e-learning contexts. According to McAdam, Miller, and McSorley (2019, pp.195-198), Contingency theory proposes that organizational efficiency is achieved through matching organizational traits to contingencies that reflect the organization's situation. The discourse and practices of systematic quality assurance and quality control have spread throughout the world, resulting in market-based models associated with neoliberalism's ideology and policy and expressed in economic rationalities such as new public management, total quality management, public choice, and human capital to a large extent.

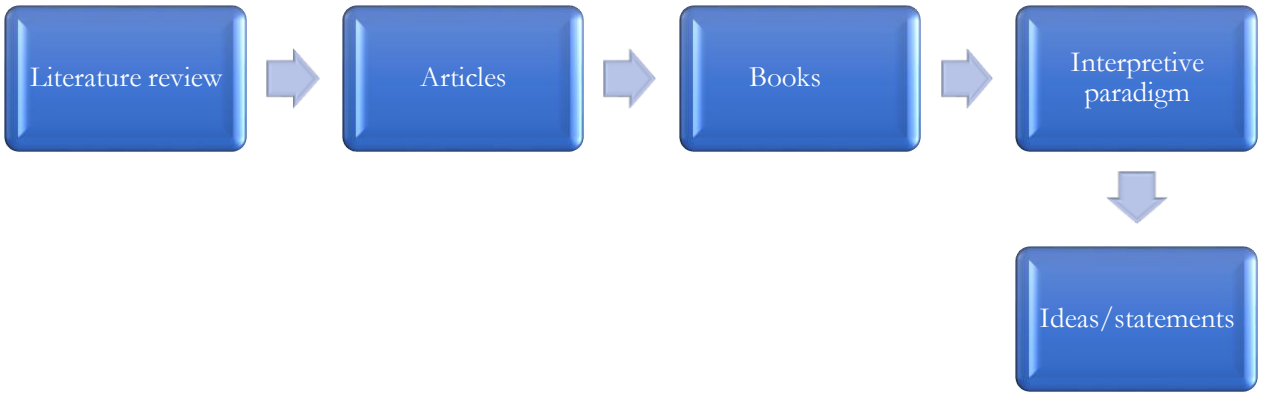

Figure 2.
Research Design

Data Collection Tools-Documents

From 1999 to 2021, articles and books were chosen and reviewed. From 1999 through 2021, the author prefers to use a variety of sources. Literature reviews were used as data gathering approaches by analyzing items such as articles and books that were relevant to the issue. A comprehensive literature review considers a variety of sources, such as academic journals and scholarly books. The following criteria were used to identify literature.

Data Analysis

To make sense of what this work was exploring, the interpretive paradigm was employed to analyze the findings of other writers of articles and books.

Procedure

The research began in 2018. At the University of South Africa, the paper was compiled. This is a conceptual paper that was compiled from materials from 1992 to 2021. The paper used a qualitative technique and an interpretive paradigm. The topic was investigated via a literature review.

Results

Accountability in Open Distance e-Learning

Over the last decade or so, there has been a significant increase in interest in the quality of open distance e-learning university education. Despite the fact that quality specification, assurance, and enhancement are typically complex and difficult, a variety of variables have sparked and maintained a great interest in the phenomena. As a result, students want reliable information on educational quality in order to make informed decisions about which courses to pursue. Furthermore, academics and university administrators require data to monitor and enhance their courses and programs. As a result, open distance e-learning institutions require excellent data in order to benchmark and advertise their performance (Coates, 2005, p.25). The quality of open distance e-learning education can be measured in a variety of ways at the national level. One possibility may be an evaluation of academic staff's teaching credentials (Ibid., 2005, p. 28). As a result, data on student activities can supply schools with useful marketing and recruitment data, as well as assist them become more attentive to students' learning needs. Therefore, only accurate and trustworthy information on what students are doing in the open distance e-learning environment will allow open distance e-learning institutions

to progress beyond taking student actions for granted. Furthermore, data on student participation can be used to determine the university's productivity in an open distance e-learning setting (Coates, 2005, p.32). As a result, the way quality is defined affects how quality assurance is used to check the quality of processes or outputs (Cardoso, Rosa, Videira, & Amaral, 2019, p. 249). As a result, quality in higher education does not appear to be a singular and absolute concept, leading to the formation of several quality standards and quality assurance systems over time. Quality, on the other hand, will be treated as a multidimensional notion in this study, with many and associated meanings to quality assurance that can be identified but not totally separated. Similarly, quality's multidimensional nature must be linked to it encompassing various higher education dimensions, such as "the quality of inputs, outputs, and processes, which must be combined with the demands put forth by students, universities, and society each time one intends to assess quality." Although quality is a relative concept, it is influenced by how different stakeholders view it: 'providers (e.g., funding bodies and the community, taxpayers); users of goods (e.g., students); users of outputs (e.g., employers); and sector personnel (academics and administrators).' It will be used interchangeably with the term quality assurance (Ibid., 2019, p. 249).

Contingency Theory

This study looked at the concept of quality assurance in open distance e-learning systems via the lens of contingency theory. Contingency theory posits that organizational efficiency can be reached by matching organizational features to contingencies that reflect the organization's condition, according to McAdam, Miller, and McSorley (2019, pp.195-198). They argue that common contingencies (also known as contingency variables) such as strategy and culture can be used to ensure quality in an open distance e-learning scenario. From this standpoint, open distance e-learning institutions can improve their performance by better fitting and aligning their defined set of contingency variables, and therefore the changing external environment, to their defined set of contingency variables. This fit procedure is regarded a dynamic and continuous process in fast-paced open distance e-learning circumstances. Contingency theory comes in helpful when there isn't a clear overall Quality Assurance Framework (focusing on contextually grounded ways based on contingency fit rather than a single best strategy to quality assure an open distance e-learning institution). In this paper, I argue that quality assurance as a strategy can enable quality assurance professionals in the open distance e-learning setting have a strategic orientation, and that it is a contingent variable that can impact the use of quality management processes. Institutional culture, according to McAdam, Miller, and McSorley (2019), is a situational characteristic that influences the implementation of quality management systems.

Quality Assurance as a Principle in Open Distance e-Learning

The Higher Education Quality Council (HEQC) in South Africa confirms its commitment to developing and implementing a quality assurance system that is tailored to the demands and realities of South African higher education. In more precise terms, the HEQC aims to use quality assuarnce as a mechanism to assist institutions in achieving the goals of higher education as outlined in the White Paper on Higher Education from 1997, namely: (1) to meet the learning needs and aspirations of individuals throughout their lives through the development of their intellectual abilities and aptitudes. Higher education should prepare people to make the most of their abilities and the chances for self-fulfilment provided by society. It is thus a crucial instrument for attaining equity in the distribution of opportunity and accomplishment among South African residents as a significant allocator of life chances. (2) To meet society's development needs and offer the labour market with the ever-changing high-level capabilities and expertise required for a modern economy's growth and success in a knowledge-driven and knowledge-dependent society. Higher education prepares students to fill specialized social roles, enter learned professions, or pursue careers in administration, trade, industry, science and technology, and the arts. (3) Assist in the socialization of informed, responsible, and constructively critical citizens. Higher education promotes the development of a reflective capacity as well as a readiness to analyze and update existing ideas, policies, and practices in the sake of the greater good. (4) To contribute to knowledge production, dissemination, and assessment. Through research, learning, and teaching, higher education pursues academic knowledge and intellectual inquiry in all realms of human understanding (Council on Higher Education, 2011, p. 12). Pitsoe and Letseka (2016, p. 96) agree that evaluation in open distance e-learning contexts necessitates making quality expectations and standards transparent and public. Quality assurance is not a new concept to them because it is on the agenda of many educational institutions throughout the world. Quality assurance can be used as a tool for rankings in higher education within the academic world and in higher education policies. Although some may reject it, they contend that: (1) Quality assurance is not free of cultural hegemony as a power relations construct, and (2) Quality assurance in Virtual Learning Environments should be directed and informed by Paulo Freire's humanizing pedagogy. As a result of Covid-19, open distance e-learning institutions are under increasing pressure to ensure that their virtual learning activities are supported by reliable quality assurance processes. So, quality

assessment is a quality evaluation procedure that entails assessing open distance e-learning institutions' actual performance to a set of benchmarks developed either from the institutions' mission statements or from international standards (Tsiligiris & Hill, 2019, p. 2). Internal or exterior bodies can carry out this process. Improving quality is what quality enhancement is all about (Ibid, 2019, p. 2). This is mostly manifested in HEIs' efforts to improve teaching quality through staff development programs. The problem with this strategy is that it frequently produces qualitative and non-measurable results. Quality management is the process by which an institution maintains and improves the quality of the education it provides to its students and the research it conducts. It is supported by policies and systems (Ibid, 2019, p. 2). Similarly, Stracke (2019, p. 187) believes that quality management extends beyond quality assurance to include manufacturing processes in order to attain higher quality. That is, quality management use the expectations-perceptions strategy to ensure and improve quality. This means that quality management must strive to close the gap between the expectations of various stakeholders, such as students and external quality certification agencies, and their views of the provision's outcomes and product.

This first viewpoint considers quality in terms of both a cultural/psychological and a structural/managerial component. The first corresponds to the academic community's engagement with quality as well as the values, expectations, and dedication of higher education institutions. Although values and expectations differ by discipline or scientific field, it is reasonable to believe that when all institutional players share the same values, beliefs, expectations, and dedication to quality, a "organizational culture of quality" can develop. The dedication of teaching and non-teaching employees to quality improvement processes is critical to the quality of open distance e-learning educational services. The structural or managerial component also refers to a more formal aspect of quality, such as institutional structures, processes, and procedures targeted at improving quality. Internal structures supporting the institution's staff in their everyday work, particularly activities connected to quality promotion, are among these structural aspects. According to this viewpoint, quality is everyone's duty, which means that everyone must participate to ensuring that "the right things are done right." Furthermore, quality should be determined by the open distance e-learning institution's ability to meet the needs of the academic community first and foremost. This is in line with the concept of quality as perfection, yet it could also be seen as change and improvement. Rather than focusing on how to attain specified objectives as efficiently as possible, the focus should be on whether transformation and qualitative change can be realized (Cardoso, Rosa, Videira & Amaral, 2019, p.251). Because of technical advancements, the author assumes that open distance e-learning environments are unpredictable and unreliable in terms of program quality. Similarly, Donaldson (2015, p. 609) considers uncertainty to be the inability to foresee which course of action will result in the intended consequences due to unpredictability or a lack of knowledge. As a result, while the environment is a primary source of uncertainty, it is also possible for uncertainty to originate from the work within the open distance e-learning institutions. Donaldson (2015) believes that seeking to innovate in product or service, or to supply them in new ways, creates a lot of uncertainty (e.g., online). Furthermore, when uncertainty is low, operations become normal and can be captured by top-down rules, while organizational functions become specialized and well-defined; this form of structure is referred to as mechanistic. Where uncertainty is high, however, operations must rely on the quality assurance of quality assurors working in open distance e-learning environments.

To appreciate the concept of quality assurance in open distance e-learning environments, an understanding of effective leadership vs. efficient management as a conceptual framework for successful leadership and efficient management practices as crucial requirements in distant e-learning is required. As a result, management in open distance e-learning must be both a function and a social position, commonly referred to as leadership, that demonstrates the authority of the individuals participating. Leadership in the field of quality assurance must be defined as a combination of zeal, integrity, warmth, and encouragement. There should be a functional relationship between management and leadership in terms of quality assurance efficiency and leadership effectiveness. It implies that academic employees in leadership positions with responsibility for quality improvement in open distance e-learning environments have a dual role: (1) Quality assurors must be successful leaders in determining appropriate teaching and research quality improvement targets, and (2) Efficient managers must effectively allocate available resources to meet established goals. Managerial leadership abilities and techniques in open distance e-learning contexts must be context-specific due to the varied open distance e-learning characteristics (e.g., public, private, profit, non-profit).

Quality assurance management should be a more flexible activity in open distance e-learning environments, focusing on context-responsive approaches/methods and associated managerial understandings, traits, and abilities in a variety of situations. According to Parvin (2019, p.741), intellectual, technical, interpersonal, and political qualities are essential for management in general and quality assurance in particular. For QA supervisors in open distance e-learning, personal orientation, dependability, open-mindedness, emotional management, and self- and others'

development (such as continuing professional development, performance assessment, peer observation, self-improvement, and providing developmental feedback) are all important skills. As a result, open distance e-learning institutions should be assessed for their learning culture based on seven distinct but interrelated action imperatives: creating continuous learning opportunities; promoting inquiry and dialogue; encouraging collaboration and team learning; empowering people toward a collective vision; connecting the organization to its environment; and establishing systems to support the organization's learning culture. As a system that resembles conventional systems, quality control is essential for quality assurance. It assesses if the higher education services provided via open distance e-learning have satisfied the required standards. This control must take place at the very end of the manufacturing process and is usually performed by a third-party person or organization. The goal of quality assurance should be to reassure stakeholders that the product or service satisfies defined criteria. Standards might range from meeting minimum criteria to exceeding internal and external quality inspectors' expectations. External stakeholders, notably quality assurance authorities like the UK's Quality Assurance Agency (QAA) and South Africa's Council of Higher Education (CHE), have primarily pursued this as a means of assuring minimum necessary standards, rather than quality development (Tsiligiris & Hill, 2019, p. 1). Furthermore, quality audit is required in quality assurance to ensure that strategic objectives drawn from the mission statements of open distance e-learning institutions in terms of teaching and learning are met. Quality audits should be carried out by third parties (Ibid, 2019, p. 1). Given what has been discussed so far, quality assurance standards are likely to range from meeting minimum criteria to exceeding the expectations of internal and external quality inspectors.

Aspects Promoting and Constraining Quality Assurance in Distance e-Learning

Organizational context aspects influence the quality culture of open distance e-learning institutions (Parvin, 2019, p. 742). Managerial elements that can be considered promoting factors include (a) a continuous improvement strategy; (b) clear policies, procedures, and system responsibilities; (c) quality management systems; (d) staff and student involvement in organizational decision making; and (e) taking into account evolving student demands. (1) Hierarchical structure/structural division; (2) a lack of policies, processes, systems, and responsibilities; and (3) a lack of resources are all stumbling blocks. (3) A lack of staff and student participation in organizational decision-making; and (4) a lack of resources. There are also promoting leadership elements, such as I leadership dedication and talents; (ii) ability to perform various tasks; (iii) build a climate of trust and shared understanding; (vi) distribute resources; set and communicate policies; and (v) form partnerships and manage people. Top-down (managerial) approaches to quality management implementation, as well as a lack of leadership commitment and abilities, may be limiting factors. Furthermore, in the open distance e-learning scenario, managers acting as communication gatekeepers' focus on inspection and control might be perceived as a barrier to quality assurance (Parvin, 2019, p. 742).

To remain sustainable in a changing and competitive market, open distance e-learning institutions should choose those activities that are based on innovation. Leaders and quality assurance managers should steer the innovation processes, since they are to generate innovative recommendations for increasing open distance e-learning institutions' performance and developing innovations that adhere to quality requirements. However, there are some obstacles that may stymie creativity in open distance e-learning environments. The institution's culture may not promote innovation; institutional leadership and management may be unable to reveal the main directions of the innovation activity supported by available knowledge and skills of instructors; adjustment to the institution's changed objectives may be lacking; and widespread participation of instructors in the innovation activity may be lacking (Jamal & Tilchin, 2019, p.68). Leadership in open distance e-learning should be a dynamic process with a complex mix of human abilities, personal traits, attitudes, and behaviours that consistently promote ethical and effective communication. Quality assurance should consider that open distance e-learning is a dynamic process with abilities, traits, beliefs, and actions that change over time. The obvious conclusion that can be made is that quality assurance method should prioritize change management capabilities, followed by boosting quality assurance auditors' listening skills and improving their conflict resolution abilities (Ewing, Remund, & Dargay, 2019, p.34).

What are Quality Pointers in Quality Assurance?

According to the fundamental structural contingency theory, a greater fit between structure and contingency leads to better performance. It will provide better results if it adopts the degree of (say) specialization that corresponds to that size rather than the level of specialization that corresponds to the lower level of size. Specialization aids success, but so does increasing the size of the organization. As a result, executives are lured to grow their institutions from unfit for a lesser size to unfit for a greater size. The organization can expand from modest to huge over time by advancing from one fit to the next. This could explain why the size and scope of distance education e-learning institutions varies so much (Donaldson, 2015, p. 612). According to Woodhouse (1999, p. 39), quality assurance features, as well as the

criteria by which the pointers will be scored, and maybe performance pointers for the criterion, must be established unambiguously in advance. Performance markers are used in a variety of ways, depending on the institution. Performance pointers must be specified by distance education e-learning institutions, including why and how they are used. As a result, quality assurance personnel must report on a system-wide set of performance indicators, which are subsequently made public and accessible to students.

Lopez, Yanes, Salgado, and Vergara (2016, p. 128), on the other hand, believe that e-learning institutions should prioritize the following quality assurance indicators:

Academic pointers: A profile of academics who assist with the school's academic operations, with a focus on learning and research.

Institutions in terms of developing a relevant mission and vision, establishing institutional legitimacy, achieving internal and external standards and goals, and procuring resources for optimal institutional functioning; indicators relating to support services for the institutional community (students, faculty, alumni, and so on); indicators relating to administrative pedigrimage (students, faculty, alumni).

Student Assistance Suggestions: A set of quality indicators relating to the availability and responsiveness of student support services—for example, how well student complaints are handled; indicators relating to the profile and characteristics of the student population, from prospective students to alumni; and indicators relating to the profile and characteristics of the student population, from prospective students to alumni; and indicators relating to the profile and characteristics of the student population, from prospective students to alumni.

Indicators of instructor competency, such as programs and courses that prepare students for work; indicators related to the institution's academic offerings, such as academic programs and degrees, as well as their organization, review, and evaluation; indicators related to the institution's academic offerings, such as academic programs and degrees, as well as their organization, review, and evaluation; indicators related to the institution's academic offerings, such as academic programs and degrees, as well as their organization, review, and evaluation; indicators related to the institution's academic offerings

Student Performance Indicators: A set of quality indicators for student participation in the curriculum, faculty, and staff, as well as increases in knowledge, skills, and abilities that lead to gainful employment, such as improved critical thinking skills (Njiro, 2016, p. 85). (7) Physical Resources: These are indicators of the school's physical resources, including academic offerings and instructional model, research, cultural and sporting facilities, and other resources used to accomplish its mission (Njiro, 2016, p. 85).

Why is Quality Assurance Important in Distance Education e-Learning Institutions?

Internal mechanisms, as well as peer assessment by representatives from other schools and external accreditation through professional organizations) have always ensured quality in distance education e-learning institutions (Anderson, 2006, p. 162). Today's open distance e-learning higher education institutions must adapt to produce graduates, conduct research, and transfer technologies to the public. To improve the community's and nation's competitiveness, higher education must also produce innovation. Higher education institutions have three responsibilities: teaching, research, and community service (HEIs). Distance education e-learning institutions must utilize quality assurance with high-level knowledge to be competitive, and every supporting activity must be submitted to quality control at distance education e-learning institutions. Academic administration, finance and accounting, human resources, student service, industrial partnerships, and campus infrastructure are just a few of the six supporting activities that must be quality certified to meet three university obligations (main process) (Jamaluddin, Ramdhani, Priatna, & Darmalaksana, 2019, p. 1269). The lack of reporting requirements, as well as the importance of reputation for both the quality assuror and the Open Distance e-Learning institution as a customer, suggest that the mutual benefits of disclosing findings in relation to sustainability quality assurance reporting will need to be explored (Michelon, Patten & Romi, 2019, p. 401). In open distance e-learning situations, the adoption of quality assurance vs. continuing quality assurance activities is crucial. We expect open distance e-learning institutions to be encouraged to disclose their flaws for both initial and ongoing interactions with quality assurors if quality assurance can help them establish legitimacy for their reporting and services, given the difficulty of finding problems prior to reporting (Ibid, 2019, p.412). To provide quality assurance, leaders of remote education e-learning institutions should collaborate with a number of players. The course coordinator and teaching staff, course administration, and program board are all important stakeholders, but keep in mind that the course coordinator is usually a member of the teaching staff with additional quality assurance responsibilities for a course (Stensaker, Hovdhaugen & Maassen, 2018, p. 704). The importance of managerial–collegial components in Quality Management procedures for study programs must be understood by these important participants in the quality assurance of study programs. Because students are direct

consumers of the services that universities give to students as key clients of distance education e-learning services, students are one of the most important participants in gauging university quality among the distance education e-learning stakeholders. As a result, universities must make a compelling academic offer to them. It's worth noting in this regard that university rankings are increasingly dependent on criteria that consider reputational issues. The teaching component (a measure of a university's learning experience and quality) contributes for 30% of the total score in the Times Higher Education Ranking of Universities, for example. Similarly, accreditation authorities consider student happiness while evaluating university academic programs.

To recruit and retain students, higher education institutions must understand their students' perceptions of quality (Marimon, Mas-Machuca, Berbegal-Mirabent & Llach, 2019, p. 185). Quality assurance should be a continuous process that evolves over time, with the opportunity for continuous improvement in service for the same consumers (students) in the hands of distance education e-learning institutions, allowing service providers ample time to improve their service quality. E-learning institutions that provide distance education have the opportunity to learn from their mistakes and go above and beyond for their students (Latif, Latif, Sahibzada & Ullah, 2019, p. 771). Data quality in quality assurance should comprise attributes like accuracy, timeliness, precision, reliability, currency, completeness, relevancy, accessibility, and interpretability, according to Azeroual and Schöpfel (2019, p. 2). The consumer's (students') point of view should be prioritized, and data should be easily available, interpretable, and helpful to them. This finding has major implications for developing a quality assurance framework that is both user-friendly for students and accessible to potential distance education e-learning students. Academic administrations, finance and accounting, human resources, student services, industry contacts, and campus infrastructure are all supporting activities that require quality certification in order to support remote education e-learning institutions.

Donabedian Phases of Quality Assurance

Individual institutions, according to Woodhouse (1999, pp. 36-37), are responsible for quality assurance and should be held accountable to the public. Reviews can be used for a variety of purposes, including the following:
Assessment: To be able to answer the question, "Where are you now?"
Improvement: to be able to choose where you want to go?
Accountability: Being able to look back and see what you did with the resources you were given.
Professional certification/accreditation: To determine the capabilities of your graduates.
Determining the problem: Can you figure out what's wrong?
Issue-solving: determining what actions you can take in response to a problem.
Funding: How do you figure out how much money you'll need?

It is critical to rely on Donabedian steps when performing quality assurance. In the open distance e-learning setting, structure refers to variables that influence the context, such as fiscal resources, academic content, and human resources (Botma & Labuschagne, 2019, pp. 364-365). The term "process" relates to what is being done, specifically the execution of open distance e-learning education programs. Our criterion should be whether or not the teaching and learning activities allow for the realization of all of the underlying theories (Ibid, 2019, p. 367). Similarly, an outcome must represent the expected positive or negative change because of QA program implementation (Ibid, 2019, p. 368). As a result, quality assurors in open distance e-learning as assessors are expected to participate in scheduled teaching and learning activities, assemble evidence that satisfies the outcomes, and judge whether students have met the program's purpose. To understand quality assurance using Donabedian procedures, we must first understand the structure, technique, and expected outputs.

Structure: How do we fund the quality assurance programs of distance education e-learning institutions? How do we connect with people, and what concepts, ideologies, and frameworks promote the construction of quality assurance programs?

Process: Do students grasp the substance of the underlying ideas employed in the remote education e-learning situation because of teaching and learning activities? What principles/theories/frameworks support the program evaluation processes? According to this study, the Donabedian phases (structure, process, and outcome) are crucial in redefining quality assurance in open distance e-learning situations.

Discussion

Sub-problem 1. How is accountability in open distance e-learning done?

Data must be used by academics and university administrators to monitor and improve university programs. As a result, data is required for open distance e-learning institutions to benchmark and advertise their performance (Coates, 2005, p.25). The teaching credentials of academic professionals should be evaluated to determine the quality of open

distance e-learning education (Ibid., 2005, p. 28). As a result, student activity data may provide schools with valuable marketing and recruitment information, as well as help them become more responsive to gifted students' learning needs.

Sub-problem 2. How is quality assurance as a principle used in open distance e-learning?

Institutions must employ quality assurance to help them achieve their higher education goals. It can be used to meet the learning needs and aspirations of gifted students all their lives as their intellectual abilities and aptitudes develop. Higher education should prepare gifted students to maximize their abilities and societal opportunities for self-fulfilment. As a result, it is a critical tool for achieving equity in the distribution of opportunity and the realization of life goals. It can be used to provide the labour market with a highly skilled workforce with the skills and knowledge required in today's knowledge-based economy. Gifted students must be prepared for specialized social roles in administration, trade, industry, science and technology, and the arts through higher education.

Sub-problem 3. What are quality pointers in quality assurance?

The teaching credentials of academic personnel can be used to assess the quality of open distance e-learning education. Student activity data can provide schools with useful marketing and recruitment information, as well as help them become more responsive to students' learning needs. To generate graduates, conduct research, and impart technology to gifted students, today's open distance e-learning higher education institutions must adapt. Higher education must be able to assist gifted students in being inventive in order to improve the community's and nation's competitiveness.

Conclusion

To improve the community's and nation's competitiveness, higher education should produce innovative practices. One of the outcomes of this paper is the possibility that remote education e-learning institutions should move away from the audit culture and toward a quality culture. The motivating reason behind quality assurance should not be bureaucracy. Distance education e-learning institutions at the national, regional, and global levels should collaborate to establish globally agreed quality assurance norms, according to the author. Quality assurance using Donabedian procedures, we must first understand the structure, the technique, and the expected outputs. Structure informs us the way institutions are going to fund the quality assurance programs to enhance student giftedness in their learning. Again, structure will inform us how e-learning institutions will connect with students, and what concepts, ideologies, and frameworks that will promote the construction of quality assurance programs and the enhancement of giftedness in students.

Process will guide students to grasp the substance of the underlying ideas employed in the remote education e-learning situation because of teaching and learning activities. Also, the process will guide students about the principles, theories, and frameworks that will be used in support the program evaluation processes to enhance student giftedness. Outcomes will inform students what they must do to achieve and enhance their giftedness.

This paper focused on the enhancement of student giftedness in Open Distance e-learning through quality assurance using Donabedian steps. Distance education and e-learning institutions should work to create a culture that produces competent and socially relevant graduates. In quality assurance, the Donabedian steps of structure, process, and outcome are critical to enhance student giftedness. Therefore, quality assurance using Donabedian steps of curricula and the environment of universities should be such that they do not hinder the growth and flourishing of students' giftedness of their talents and creativity. Rahiminia et al. (2021) agree that in identifying the talented in the education system based on correct and scientific criteria can be the first step in developing an appropriate policy plan. On the other hand, the needs, interests and problems of students must be carefully identified. Thus, that can happen if institutions can have a plan for quality assuring their programs relying on the scientific Donabedian steps to improve the giftedness of students.

Recommendations

Identification of giftedness in students should be founded on a scientific criterion with a structure, procedure, and outcome. The topic of 'Enhancing Student Giftedness in Open Distance E-Learning via Quality Assurance Using Donabedian Steps' should be explored at contact learning institutions such as schools and universities.

Limitations of Study

This is a qualitative paper that incorporates a literature review. No interviews were undertaken because this is a conceptual article. In analyzing the findings of other authors, it used an interpretive paradigm.

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Research Article

Exploring e-tutors teaching of the design process as content knowledge in an Open and Distance eLearning environment

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Abstract

The purpose of this paper is to argue that for Open and Distance eLearning (ODeL) institutions to provide student support, their focus ought to be on a critical aspect of content knowledge. Central to ODeL institutions is technology which is a critical factor in student support. The main question is 'how are the varied procedural steps of the design process taught in the targeted ODeL institution". It is assumed that ODeL institutions avail competent e-tutors who offer student support by way of teaching the content knowledge of the design process. This study focused on the postgraduate students who registered for two modules for a programme (n=250) in 2020. Method: This paper followed the South African Ministry of Education for Curriculum and Assessment Policy Statement (CAPS) to investigate, design, make, evaluate, and communicate. A quantitative approach with an online survey was used in exploring the perceptions of students about e-tutors' content knowledge. Data was analysed both numerically and thematically. The procedural steps vary depending on the different ministries of education world-wide. E-tutors seems to lack the content knowledge to teach at a distance- learning mode. Teaching design process to student teachers requires insights in the procedural steps of the design process curriculum. E-tutors should be provided with training in e-tutoring the design steps.

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Introduction

The outbreak of Covid-19 that swept the entire world enforces the use of various online platforms which help students carry on their learning process at a distance. The online platforms provide both students and e-tutors with reading materials, lessons, as well as video-conferencing and videos from YouTube (Boubekeur, 2021). Similarly, Maré and Mutezo (2021) found that UNISA has embraced the use of online learning and e-tutoring as a new approach to teaching and learning in an ODeL environment and the university launched an integrated e-tutor model in 2013 as one of its student support programmes that enhance student success, reduce student drop-outs, increase qualification completion rates and motivate life-long learning. UNISA, an institution from which this study was conducted, its students stand to benefit from such an initiative since it exploited the Internet which has become a global system for both the students and researchers to easily undertake any scientific studies.

In the light of the above, an idea that an institution chooses to exist in a space distinguishable as ODeL is laudable and admirable. According to Pratiwi and Ariani (2020) such a learning context ought to be able to support the smoothness and flexibility of learning by the students who chose to enrol in that institution. To be able to fulfil this mandate, certain pedagogical competencies that are linked to the demands and expectations of students as the clientele should be fulfilled. In the myriad of reasons found in the study, this is one of the reasons why e-tutors must ideally have specific skills to manage such an environment. Such skills demand from an e-tutor to become a figure which is

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able to: become a driving force of learning, tutor as facilitator and source of information and a tutor as an organizer and an observer of learning developments (Pratiwi & Ariani, 2020). Yet, it is still not clear how effective is the content knowledge from the e-tutors whose responsibility is aimed to support the learning of content for students at a distance. In this paper, it is still to be established how much an impact the acquisition of such content knowledge influences the effective teaching of the design process. To effectively teach the design process, it is important that e-tutoring should be sought as a support mechanism for the students taught at a distance.

E-tutoring is perceived as central for online learning since it is directly connected to technology. Dilmac (2020) believes that the use of technology in distance education settings eliminated time and space constraints. In support of Dilmac (2020), Alessandrini (2016) think that technological revolution is credited because it paved way for the emergence of an alternative from face to face to an ODeL tutoring system. In this system, technology acts as a collector of links between users, who, united by the same aims and interests, benefit from multimedia resources and interconnected practices. Also, Maphalala and Mpofu (2020) noted that technology provides students with the abilities to share useful information which enhances learning beyond the tutorial sessions. Aggregating the various functions of technology by the above authors, it strengthens the need for e-tutor support roles than might normalise the learning of content knowledge especially of the design process by the students at a distance.

This is because the legitimacy and enhancement of e-tutoring has shifted from training in disciplinary knowledge to practical operational knowledge (Vegliante & Sannicandro, 2020). At the same time, the need to strengthen and rethink the role of the e-tutors' content knowledge has increased particularly in the context of ODeL (Halverson et al. 2019; Youde, 2020). From these perspectives, an assumption is that the function of an e-tutor becomes decisive in the knowledge management practices of learning (Vegliante & Sannicandro, 2020). The concept of knowledge was pioneered and popularized by Lee Shulman (1986) and later Wilson, Shulman & Richert, (1987) that it is knowledge which includes what makes learning of specific topics easy or difficult (Shulman, 1986, 1987). A topic which is addressed in this paper is the design process and its importance is that the design process offers a framework for e-tutors to engage with problems of practice where they view themselves as knowledge experts who empower with their abilities to address problems at a time in which challenges abound during the teaching of the design process (Henriksen, Gretter & Richardson, 2020).

The actual teaching of the design process requires well-prepared e-tutors who become central in building the students' learning paths. Also, in the view expressed by Hubers, Endedijk and Van Veen (2020), is that teaching practices are fundamental since the management of curriculum in specified subjects is to give students opportunities of support to interact with and learn about the curriculum with their e-tutors. At the same time, particular attention should be placed on e-tutors with skills which enrich e-tutoring abilities which are on par with the attitudes to nurture, embrace and change students' content abilities of the design process Wrigley & Straker (2015). In the light of the contextualization, e-tutors' content knowledge is deemed most important in building such a knowledge learning path. Knowledge including content knowledge is central to all teachers with an assumption that all teachers are experts in the content that they teach (Shulman, 1986, 1987). Content knowledge in this paper is key for the e-tutors to support students' needs and expectations and their overall interpretations about the delivery of the curriculum from their e-tutors. This is sensible since according to Winarno et al. (2020) the implementation of the design process is still very limited at the university level, especially in subjects related to the Technology Education. To mitigate the direct impact of this understanding in furthering the study, literature was sought from studies which were conducted with teachers in schools though not limited to (Maclean et al. 1991; Mose Biskjaer et al. 2017; Cardella et al. 2014; Mesutoglu & Baran, 2020; Lin et al. 2021; O'Brien et al. 2016; Paganelli et al. 2016; Hynes et al. 2017; Smith et al. 2020). As a result, the implication from this study is to be seen as an immense contribution to literature.

Theoretical Framework

Connectivism was employed as a theoretical framework which was coined by Siemens (2012) notes that within the theory, three levels of teacher presence include cognitive presence, social presence, and teacher presence. Cognitive presence promotes the construction of sustained communication through networks while social presence encourages the engagement of different communication media for sustained communication. And teacher presence indicates to the methods a teacher chooses to use which can promote independent online learning.

Research questions

An overarching question this paper is trying to explore is: How do e-tutors' content knowledge influence the effective teaching and learning of the design process?

Research Objectives

- To determine the influence of the e-tutors' content knowledge on effective teaching of the investigation step of the design process
- To find out the influence of the e-tutors' content knowledge on effective teaching of the design step of the design process
- To explain the influence of the e-tutors' content knowledge on effective teaching of the make step of the design process
- To look at the influence of the e-tutors' content knowledge on effective teaching of the evaluate step of the design process
- To determine the influence of the e-tutors' content knowledge on effective teaching of the communicate step of the design process

Literature Review

Jureta (2021) believe that the design process depends on what the requirements are about from the client, how much resources can be committed, and throughput, or roughly speaking, how much of the requirements can be satisfied by how much resources. This, in turn, begs the question of what can we expect to gain from that commitment of e-tutors in distance e-learning environment. And therefore, there are economic relationships at play when we do requirements prioritisation. On the other hand, Doukakis (2021) found that e-tutoring is a distance learning service that utilizes digital technologies. Its programs run in real time and are used by students to support and enhance their learning. To better situate the design process in this paper, key principles which gird the design process will be presented while at the same time acknowledging the multiplicity and the different approaches to the design process. From the use of such key principles, the design process curriculum from which the design steps are a focus, it stands to benefit since such principles are key as they appropriate how teaching in the subject progresses. In this way, the design process and the careful consideration of different design process are key due to their impacts on the quality of the instruction (Schultz & De Mers, 2020). The idea of quality of instruction is supported since the design process holds much promise for developing skills for students to meaningfully connect and creatively contribute towards solutions of 21st century problems (McCurdy, Nickels & Bush, 2020). Again, this way of thinking is helpful in considering the mutual relevance of the steps of teaching the design process (Yata, Ohtani & Isobe, 2020). In this paper, in line with the Curriculum Assessment Policy Statement (CAPS) design process is understood to be a creative approach of finding solutions to problems which are identified Department of Basic Education (2011).

Considering that design process is at the core around which the everyday teaching revolves, there is a need to consider the way experts in the field articulate how the design process is taught. This process is implemented through steps of design and redesign, followed by the other steps of investigate and explore (Hodges et al. 2020). At the same time, according to Design and Technology framework Institute of Design at Stanford (2016), the steps of the Design and Technology framework are suggested as: empathize, define, ideate, prototype and test. While the Stanford model has five phases of design thinking, referred to as modes, which are worked through toward a problem solution or resolution (Henriksen et al. 2020). Also, the Department of Basic Education (2011) in the South African schools' curriculum in its Curriculum Assessment Policy Statement recommends procedural steps of investigate, design, make, evaluate, and communicate (IDMEC). In terms of the main differences between the steps, the different articulations assist those who are concerned with teaching the design process to check how far they are in achieving their strategic goals. In this paper, the IDMEC was used as a guiding process to arrive at answering the research question. However also keeping in mind a contrast view by Gross et al. (2020) that the procedural steps provide structure of logical steps but somehow restricted regarding their procedural guidance into the sequence of steps which lack structured support for designing new processes. Even against this backdrop, the aim is to provide an answer to the research question which was formulated for the paper.

Therefore, the IDMEC process would receive attention and premised that it can only be implemented by procedural steps where investigation is the first step of the procedural steps. The search for available literature on the design process steps was optimized by keeping in mind of the different articulations which were mentioned earlier. The process began with searching for commonalities between the different names articulated. For an example, there were similarities between investigation and ideate. Those terms which provided differences to the IDMEC process were overlooked since they could not provide the necessary contribution to further discussions about the procedural steps.

Then, the *investigation stage* must be considered as the first stage of conceptualizing the design process. Maclean et al. (1991) far back then provided what is known about the design step that it is about finding solutions which enable the

creation of new artifacts. Built from this understanding, several studies (Kang et al. 2018; Cardella et al. 2014; Mose & Biskjaer et al. 2017) have reported on this investigation stage. From which, Mose & Biskjaer et al. (2017) study affirmed that teachers showed understanding on this first step of the design process. Similarly, Cardella et al. (2014) study reported the same results that teachers achieved advanced level of understanding the investigation step. At the same time, Kang et al. (2018) study also found that teachers had more knowledge about the investigation step. Later, an account by Mesutoglu and Baran, (2020), contrasted the previous studies (Kang et al. 2018; Cardella et al. 2014; Mose & Biskjaer, et al. 2017). Their studies are of a view that the investigation step was characterised by confusions from the teachers who participated in the study.

The design step is the second for the design process which involves the generation and evaluation of alternative solutions. Key aspects by Goldstein et al. (2018) and Walker et al. (2018) about the step is that it is characterised by describing the pros and cons, and by making decisions about the criteria and constraints. In the light of what is distinguished as important features in the step, some key studies (Lin et al. 2021; Mesutoglu & Baran, 2020) were developed for the design step. From which Lin et al. (2021) study has shown that the preservice technology teachers spent too much time on problem definition and were slow to transition into developing alternative solutions. Whilst a similar study based on the design step by Mesutoglu and Baran (2020) was able to affirm that teachers did not frequently engage in revisiting multiple design steps and also that they showed lower level understanding of possible solutions and constraints about a product. In view of what is highlighted from Lin et al. (2021); Mesutoglu and Baran, (2020) studies, a contrasting study by Ortega-Tudela et al. (2021) found that future teachers showed creativity to address problems emanating from the design step activities. Addressing problems in this section equates to what was earlier identified in (Goldstein et al. 2018; Walker et al. 2018) as a key aspect to effectively identify pros and cons in the design step.

Make is the third stage of the design process which involves the construction of models or prototypes. And an idea that this stage is that it is a manifestation of the design phase Lin et al. (2021) holds well in this section. About how the stage is known, make is exactly what it sounds like: designing, creating, and building with potential educational benefits crafting practices aimed at the design process Peppler et al. (2016). Studies on this stage of the design process according to O'Brien et al. (2016) and Paganelli et al. (2016) have shown a general struggle for teachers to work within open-ended, non-traditional structure of making in the design process space. In support of O'Brien et al. (2016) and Paganelli et al. (2016), Hynes et al. (2017) also indicated that teachers could not effectively integrate the making design process step into their classrooms. In contrary to O'Brien et al. (2016); Paganelli et al. (2016); Hynes et al. (2017), and Lin et al. (2021) though in a different context, found that students were able to share information and found it easy to communicate on prototypes which were created. This finding is applicable since Smith et al. (2020) found that there is still a lack of research available on the integration of making in teacher education.

The evaluate stage is the fourth practical skill section of evaluating artefacts which were provided during the making stage. Lin et al. (2021) highlights that the evaluate stage is thought of as a stage where teachers are fundamentally rethinking and overhauling their designs. A central focus of a study by Fajarwati et al. (2020) in which the authors found that that in this stage users have a better idea of the constraints inherent in the product.
This was a contrast with what was found in studies by Kang et al. (2018) and Wendel (2014) where they held a view that teachers struggled with knowledge of evaluating information for processing towards the finalization of the design process.

Communicate is the final stage within the design process where language is used to communicate about their projects. Also, that the purpose of this step is to confirm that a client's needs are met and that all team members understand how to communicate the final solution (Lin et al. 2021). Assertions in studies by Kang et al. (2018); Oehlberg and Agogi, (2011) claimed that there were some confusions from teachers about communicating their understanding of final ideas for the final solutions. These results were justifications from a study by Hynes (2012) and Wendell (2014) that there were some confusions about which information can serve as important to communicate the best ideas about this step. Unlike Hynes (2012); Kang et al. (2018); Oehlberg and Agogi, (2011); and Wendell, (2014), Ortega-Tudela et al. (2021) argue that communication with teachers increased and this was a positive indication in this stage of the design process.

Method

Research Design

A quantitative approach was employed to assess the perceptions of student teachers about their e-tutors' content knowledge of teaching design process in distance learning courses (Creswell, 2009). A survey instrument was created

and distributed to students for them to complete. This study employed qualitative approach. It sampled 1500 participants from which two hundred and fifty research participants responded to the survey. Qualitative data from open-ended survey toward online discussions were collected and analysed based on content analysis using five constructs. The feedback was coded based on the pre-determined themes on Likert scale.

Participants

This paper was designed to survey 1500 students who registered for two modules of undergraduate and graduate modules. Two hundred and fifty participants replied to the survey questions. The students who were involved in the survey were characterised by of a cohort of teachers who already were qualified as teachers but who pursued extra qualifications, also to those who are still new and who have just started to pursue a career in teaching. From which, two hundred and fifty students returned their surveys via their myUnisa email addresses.

Research Instruments

A questionnaire was developed as an instrument to explore the students' perceptions about their e-tutors' content knowledge of the design process. An original instrument was adapted and prepared by the researcher for the PhD study and it was validated then. The questionnaire was developed using a Likert scale [Strongly Agree; Agree; Strongly Disagree, Disagree; Neutral. The analysis was done through frequency tables and they were mapped against participants' responses. The validation was done by looking at what the students said in their responses. The original instrument consisted of 47 scale items which were availed first as a pilot sample instrument given to ten students to pilot their responses. From the students' responses, the instrument was reduced to 18 items of which 5 of the items constituted the framework in this section of the paper. In addition, two colleagues also piloted the questionnaire and their responses were incorporated into the final questionnaire instrument. For purposes of this paper, another adaptation was made since there was a need to understand the specifics about the design steps around the perceptions of students that existed about their e-tutors. This instrument is thought of as important for understanding such purpose in case of criticism since the emphasis was placed on the value of the tool. Then, a five - point Likert scale was used (Agree = A; Strongly Agree = SA; Neutral = N; Strongly Disagree = SD and Disagree = D).

Data Analysis

The analysis of the survey responses was presented based on the five constructs which were developed. Each of the constructs resolved distinct aspects which provided a situational aspect that described a preference for an item in the survey. Students were asked to identify these aspects in the survey. The aim was to ensure that the survey tool captures the essence of responses which summed a particular construct. The aim was to ensure a trail of accountability from which the results which were obtained become dependable and can become difficult to challenge. The survey tool appears as Table 1 below.

Table 1.

Procedural Steps of the Design Process

Likert Scale: %		SA	A	N	SD	D	Total
1	My e-tutor can help me to understand investigation which the first stage of the design process is	37.9	6.9	40.0	3,5	11.7	100
2	My e-tutor can help me to understand design which the second stage of the design process is	44.8	6.2	33.1	6.9	9,0	100
3	My e-tutor can help me to understand make which is the third stage in the design process	39.3	9.0	36.6	4.8	10.3	100
4	My e-tutor can help me to understand evaluation which the third stage of the design process is	43.4	7.6	33.8	6.2	9.0	100
5	My e-tutor can help me to understand communication which the final stage of the design process is	42.1	10.3	33.1	5.5	9.0	100

More explanations concerning Table 1 are discussed under the results section. In the table, SA means Strongly Agree, then A means Agree, N means Neutral, SD means Strongly Agree and D means Disagree.

Results

The students almost responded to all the questions and their responses were treated as data which was analysed and later stored as graphs which were later interpreted. Their data recording first started when a student answered the questionnaire and providing feedback. Data were collected over a period of a year since the two modules were year modules.

The study investigated the following research question: "How do e-tutors' content knowledge influence the effective teaching and learning of the design process?" From this research question, this section of results presented a total of five constructs from construct one to construct number five. The style of each construct aimed to have a specific focus on each IDMEC stages to rid of irrelevant information. The presentation placed attention on the (Agree: A; Strongly Agree: SA) values so as to retain critical focus and to obtain real insights into the discussions around how the students clarified after being asked to agree or disagree.

In responding to objective number 1 which aimed to determine the influence of the e-tutors' content knowledge on effective teaching of the investigation step of the design process, an indication from construct one is that 44.8% of students strongly agreed and agreed about their e-tutors' abilities to help them conceptualise the first design stage. This is an indication that the e-tutors lacked the abilities to help students to conceptualise the first stage of the design process. This was confirmed by those who were neutral at 40.0%, also with the results of those who strongly disagree at 3.5% while those at 11,7% disagreed with the construct.

Also, it was noted from the construct number two for design step that 51% of the students strongly agreed and agreed about their e-tutors' abilities about the design step. This was a response from the objective number 2 which sought to find out the influence of the e-tutors' content knowledge on effective teaching of the design step of the design process. Students held an opinion that their e-tutors were able to help them understand the design step of the design process. What the students articulated is positive about the construct which was formulated for the design step. A less significant influence towards these results was obtained from those who were at 33.1% neutral, to those whose value was at 9.0% in strongly disagreeing with the construct. In addition to the two results, those who agreed and whose value was at 9.0% did not influence the positive outcome which was previously recorded about the construct. In addition, it must also be noted from construct number three that 48.3% of the students strongly agreed and agreed about their e-tutors' abilities to help them understand the third stage of the design process. Students responded to the objective number 3 which needed an indication about an e-tutor who can help students to understand make which is the third stage in the design process. From the students' indication, a less preferable outcome emerged when students highlighted that their e-tutors are not able to help to conceptualise the third stage (make) of the design process. From the less preferable outcome, an ideal would have been to obtain a positive outcome. The 36.6% of those who were neutral, another 4.8% of those who strongly agreed and those at 10.3%, their results contributed to the less preferable outcome about the construct.

Another attention was paid to evaluate stage four of the design process. The attention was paid to the evaluate stage since it was based on the objective 4 which needed to establish whether e-tutors can help students to understand evaluation which is the third stage of the design process. An outcome emerged from the students that 51% who strongly agreed and agreed about their e-tutors' abilities about the evaluate stage of the design process. This outcome provided a positive insight about what students view about the construct about their e-tutors. A non-influential outcome to the results was obtained from those who were at 33,8% of those who were neutral, others at 6.2% in strong disagreement while those at 6.2% disagreed with the construct about their e-tutors.

The final objective, number 5 was about to determine the influence of the e-tutors' content knowledge on effective teaching of the communicate step of the design process. From which, 52.4% of the students had positive insights about their e-tutors. An inference about the performance of e-tutors is that students believe that the e-tutors make a positive contribution to the communicate stage (last step) of the design process. An outcome which was obtained from those who were neutral, in strong agreement and agreement did not influence what was obtained as positive insights about the construct. Their totals added to 47.6% from those at 33.1% who were neutral, 5.5% of those who strongly disagreed and finally those at 9.0% in disagreement.

Discussion

This paper investigated how the e-tutors' content knowledge influences their effectiveness in the teaching and learning of the design process from the perspectives of their students. From the employ of this purpose, the paper illuminated important insights into how the design process is taught in an ODeL space. One such insight made known is that the e-tutors lack abilities to help students to conceptualise the first stage (investigate) of the design process. This insight corroborated results in Mesutoglu and Baran (2020) study which highlighted those teachers who participated showed confusions as to how the investigation stage is taught. Out of these results, there are serious implications about this design step more so since it is intended to find solutions which enable the creation of new artifacts earlier indicated by Maclean et al. (1991). At the same time, the theoretical framework also affirmed the results where teacher presence was absent from its potential contribution of independent learning by students towards the investigation stage.

Another set of exposition was based on the results obtained about a positive articulation from the students regarding the design step of the design process. These results about the design step differ from the investigation stage which is a good sign. It means key aspects about the step of for an example making decisions about the criteria and constraints were understood as earlier indicated by (Goldstein et al. 2018; Walker et al. 2018). The results are similar to Ortega-Tudela et al. (2021) who found out that future teachers showed creativity in order to address problems emanating from the design step activities. Based on the theoretical framework with central key features which were identified, a positive articulation about the results indicated that the cognitive presence of e-tutors in the design step is heightened.

About the make stage, the students indicated a less preferable outcome when they highlighted that their e-tutors are not able to help them conceptualise the third stage (make) of the design process. There is commonality between these results and those of (Hynes et al. 2017; O'Brien et al. 2016; Paganelli et al. 2016) that there was a general struggle for teachers to effectively integrate the making design step into their classrooms. An attention paid to this step earlier by Lin et al. (2021) was that this stage is a manifestation of the design phase heightened the need for positive outcomes on this stage of the design process. From the stated, there is an implication that the e-tutor knowledge is incongruent to the Connectivism's cognitive presence idea.

It was found that e-tutors lacked the abilities to help online students to conceptualise the first stage of the design process. On the contrary, from the construct number two for design step was that 51% of the students strongly agreed about their e-tutors' abilities about the design step. Students held an opinion that their e-tutors were able to help them understand the design step of the design process In other words, the study supports the idea of Nasir and Mansor (2021) that the ability of online instructors in designing, organizing, instructing, and facilitating via online platforms are essential in the successful implementation of the hybrid learning mode.

In the last step (communicate), some positive results emerged from the students about the performance of their e-tutors. The results reported that the students believe that the e-tutors make a positive contribution to the communicate stage (last step) of the design process. Ortega-Tudela et al. (2021) corroborated these results where it was found that communication with teachers increases where detailed accounts and justifications about the decisions in the earlier steps of the design process are provided. This agrees with the purpose mentioned earlier by Lin et al. (2021) that this step is a confirmation through communication by team members to a client to indicate that their needs are met. The positive results from the students support the cognitive and teacher presence of Connectivism theory.

Conclusion

This paper investigated how the e-tutors' content knowledge influences their effectiveness in the teaching and learning of the design process from the perspectives of their students. From this main research question, an overall conclusion on the study was that the e-tutors still have not acquired the content knowledge for an ODeL environment in order to deliver the objectives of the design process curriculum. Findings in this study highlighted a need for competent e-tutors who are competent in the skills of content knowledge for the design process steps. The justification of the main conclusion is based on one insight which highlighted that the e-tutors lack abilities to help students to conceptualise the first stage (investigate) of the design process. Mesutoglu and Baran (2020) study highlighted this notion that those teachers who participated in this stage of the design process showed confusions as to how the investigation stage is taught. At the same time, the results about the design step differ from the investigation stage which is a good sign and key about the step which is the same as (Goldstein et al. 2018; Walker et al. 2018). The results are similar to Ortega-Tudela et al. (2021) who found out that future teachers showed creativity in order to address problems emanating from the design step activities.

In accordance with the third stage which is the make stage, the students indicated a less preferable outcome when they highlighted that their e-tutors are not able to help them conceptualise the third stage (make) of the design process. There is commonality between these results and those of (Hynes et al. 2017; O'Brien et al. 2016; Paganelli et al. 2016) that there was a general struggle for teachers to effectively integrate the making design step into their classrooms. The last step (communicate) produces some positive results about the performance of their e-tutors and reported that their e-tutors contribute positively to the communicate stage (last step) of the design process and agree with Ortega-Tudela et al. (2021). These positive results were congruent to the Connectivist theory which grounded the study.

Recommendations

Results which emerged from this paper were analysed using a questionnaire tool, literature and the conceptual framework which suited the purpose of the paper. From which, an indication that at 44.8% students strongly agreed

or agreed about their e-tutors' inabilities to help them conceptualise the first (investigation stage) of the design process. An indication was that the e-tutors lack abilities to help students to conceptualise the first stage of the design process. It is recommended that the design process step receive attention to create purposeful learning of the design process particularly in an ODeL context.

In addition, it was also noted from construct number three that 48.3% of the students strongly agreed or agreed about their e-tutors' inabilities to help them understand the third stage of the design process. A less preferable outcome emerged when students highlighted that their e-tutors are not able to help to conceptualise the third stage (make) of the design process. Following from the results which were highlighted, additional support for the e-tutors content knowledge is recommended since content knowledge is linked to the achievement of the set goals for the design process.

Findings in this study highlighted a need for competent e-tutors who are competent in the skills of content knowledge for the design process. Further studies that include the content knowledge with specific focus on each step or stage of the design process are recommended that could add value to design process learning in an ODeL environment.

Limitations of the Study

This paper's context was in an ODeL university with more than 300000 students worldwide. Out of this total, this study only focused on the postgraduate students who registered for two modules in Technology Education (n=250). Then the sample of the students who responded to their survey were 250 out of the 1500 who registered for the module and in the university at 300000 students in total. And this turned to be a limitation.

In addition, the ODeL institution offers its qualifications through seven colleges and institutions but this study was conducted in one college of which this resulted as also another limitation. Another limitation which was noted is that this paper focussed in only one department and only involved two modules within the department whilst there are more than twenty modules in the department. Instrumentation tool also resulted as a limitation since its inception and use was regarded as a tool for specific purpose in this paper. Despite the limitations given in this study, there is no suggestion that the authority of the paper is invaluable. Therefore, there is a need to take these limitations into account in an effort not to generalise the results but for the results to be transferable into other studies.

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Research Article

Exploring early childhood centre managers' perceptions of their roles in promoting developmentally-appropriate physical environments in South Africa

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Abstract

The aim of this research was to explore the roles of Early Childhood Centre managers in promoting developmentally appropriate physical environments for birth to four-year-old children in South Africa, and then draw implications on the quality of leadership in the centres. While significant studies have been conducted on the phenomenon globally, little has been published on how centre managers understand their roles in promoting developmentally appropriate physical environments for infants and toddlers. This research was based on Merton (1957)'s Role Theory. This was further paired with a structural-functionalism paradigm, where every individual's place and corresponding role in a social or organisational structure is appreciated. Five South African centre managers within rural communities of Gauteng North District were purposively sampled for this empirical investigation. A qualitative approach with case study design using semi-structured interviews, spot observations and taking good quality photographs in collecting data was employed. Thematic data analysis was employed to analyse the collected data. The study established that some manager-participants were cognisant of their leadership role in constructing developmentally appropriate physical environments, whilst others were unaware or oblivious of their role and influence. In addition, results also allude to potential gaps in how centre managers understand and interpret policy and curricula to fashion and sustain developmentally appropriate physical environments amid contextual challenges. The researcher, therefore, recommended that the Education Department in the country develop a strategic plan to develop leadership skills in centre managers.

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Introduction

The independence of South Africa in 1994 resulted in large numbers of young children attending early childhood centres, a privilege that was only enjoyed by whites in the Apartheid education system. This put pressure on the existing centres, prompting the government to open more centres. Early Childhood Centre Managers (ECCM) play a very critical role in supporting, promoting and directing the development of age-appropriate physical environment. However, most of these new centres did not have qualified managers to steward them. Early Childhood centre leaders' understanding and interpretation of these advances were not observable in contextually and culturally unique practices. Hence, the rationale for determining roles and responsibilities of early childhood centre managers to promote such environments for children aged from birth to four years.

The physical environment in which a child is reared has a significant influence on his/her physical, interpersonal, and temporal development. Concerning early childhood centres and school environments, it is key that physical environments are created with age-appropriate resources that would encourage the holistic development of young children. It is doubtful that managers would meet the level of acceptable criteria for most centres in the country.

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Hence, appropriate quality design standards in catering for developmentally appropriate environments and quality interaction opportunities must be provided.

A Developmentally-appropriate environment is a slippery term. This suggests that it is very difficult to agree on a common definition of a conducive physical environment. Nevertheless, Matthews and Lippman (2019) have noted that various philosophers such as Maria Montessori, Reggio Emilia and others have put forward acceptable criteria that can be used to appraise the learning environment in ECD centres. The study sought to provide more insight and add to existing knowledge on the roles of ECD centre managers and the implications on the provision of quality education in these centres.

According to Leo-Rhynie (2015), committed, motivated and well-trained centre managers and teachers should take responsibility for designing suitable, quality and developmentally appropriate learning environments. To achieve this successfully, ECCMs need to demonstrate sound pedagogical leadership which is defined by Coughlin and Baird (2013:1) as, 'the act of leading or guiding individuals or groups, understanding of how learning takes place, the philosophy and practice that supports that understanding of learning'. The South African Curriculum and Assessment Policy Statement (DBE, 2011) provides an outline for schools and teachers to design Developmentally-Appropriate Physical Environments (DAPE) for children between ages five and eight. For the younger child, ECCMs and teachers need to become familiar with additional social development and international policies to design DAPE and have adept knowledge of the young child's teaching and learning needs.

The exposure of children to low-quality physical environments deprives them of learning and general wellbeing. According to Meyer (2009), if the learning environment is not designed to meet learners' ages and developmental and individual learning styles, learning objectives may not be achieved. Rao et al. (2012) found that socioeconomic status and conducive learning environments with well-trained staff and good resources have an academic advantage over children from perilous surroundings.

In South Africa, very few studies have focused on ECCMs' perceptions of their roles in promoting developmentally appropriate physical environments from birth to four-year-old children. In this research, the researcher intends to fill up this gap by exploring the ECCMs' perceptions of their roles in promoting developmentally appropriate physical environments in the rural communities of Gauteng Province.

The Rationale

As part of the routine visits to ECE centres on behalf of the Department of Basic Education, the researcher came to experience for herself the dire, neglected and developmentally inappropriate environments at the hands of un-informed centre managers. The teachers there believe in a "one-size-fits-all" teaching and learning approach for young children. To understand the perceptions of ECCMs, the researcher posed the question: What are the perceptions of ECCMs regarding their role in promoting DAPE for children aged birth to four years? Answering this research question requires a two-fold strategy: One, is to highlight the importance of a DAPE; and secondly, to describe the role of ECCMs in promoting DAPE.

Statement of the Problem

Currently, the South African government is focusing on shifting the functions of Early Childhood Education from the Department of Social Development to the Department of Basic Education. However, the physical learning environment in the early childhood sector continues to draw attention and is of concern. The physical environment plays a critical role in the holistic development of young children and this is an area that is most neglected in the early childhood centres. This statement is supported by Miller (2011), who states that the importance of the physical environment and the influence it exerts on the quality of educational activities provided to young children has been largely neglected. The quality of interaction between children, peers and teachers may be significantly affected by the physical environment. Early childhood centre managers play an influential role in seeing to it that children are exposed to appropriate physical environments. While significant studies have been conducted on the phenomenon globally, little has been published on how some Early Childhood Centre Managers understand their roles in promoting the developmentally appropriate physical environments for young children in the country.

Literature Review

The Developmentally Age-appropriate Physical Environment

There have been substantial studies conducted globally emphasising the importance of creating appropriate physical environments for children and the roles and functions played by ECE leaders in promoting quality practices in most ECE centres (Matthews & Lippman, 2019). Thorough preparation of the physical environment including classroom and play space design, as well as creating developmentally appropriate materials has been deemed essential to the

educational process (Falk, 2018). Among the developmentally appropriate materials are child-sized age-appropriate furnishings like chairs, tables, bookshelves and toys which should be accessible to every child.

The physical setting plays an important role in the lives of pre-schoolers and can be an important component of children's experience and development when it is wisely and meaningfully designed (Tadjic, Martinec & Farago, 2015). It is the role and function of the centre managers to ensure that the physical environment is developmentally appropriate according to the set millennium goals of children, acknowledged worldwide. Their commitment may be different but roles and functions are similar throughout the world. The United Nations (2000) points out the children's right to education. At the centre of this is developmentally appropriateness which is the focus of this study. The physical environment and children's learning and development are interwoven.

The holistic development of the young child is dependent on the quality of the socio-environmental contexts (Ruey, 2010). If the physical environment is designed carefully, it can inspire choices, discoveries, and communication with the other children and the teacher (Tadjic, Martinec & Farago, 2015). International scholars believe that a safe and stimulating DAPE is fundamental for the growth of every child regardless of age, ability, sex, race, religion or language. South Africa as a developing country has also prioritised scholarly discussions on ECCMs' roles and responsibilities to ensure DAPE.

Policies and Principles Pertaining DAPE

The Government of South Africa has enacted a policy in favour of ECE centres. The national policy goes beyond protection to provision for meeting the needs of infants concerning physical, mental, psychosocial, health education. At the policy level, the importance of pedagogical leadership that promotes the young child is advocated by the National Early Learning Development Standards (DBE, 2009). Whilst quality education in South Africa is governed by The Constitution of the Republic of South Africa (1996), The Children's Act 38 of 2005 and the National Integrated Plan for ECD in South Africa (2005) protects children among other issues. These policies not only align with the roles and responsibilities of centre managers but also offer guidelines for constructing the physical environment that caters for children's rights to holistic development and overall wellbeing (DBE, 2011).

It is therefore critical that the centre manager knows and understands that the children's holistic wellbeing is of paramount importance. The centre manager safeguards children's rights, promotes inclusive practices in daily activities and knows how to proceed in cases of potential harm or suspected abuse. Furthermore, the centre manager understands national and international legislation, regulations and the centre's policies and procedures regarding children's rights and protection.

The Roles of ECCM in Providing DAPE

The country's National Educational Policy has a bearing on the quality of education as it stipulates the standard requirements for the early education centres. In South Africa and other regional countries, there is a basic standard criterion required before a centre is given a licence to operate. Educational researchers consider the following as non-negotiable; whilst being considerate of the unique socio-economic and cultural contexts of the school, the centre manager has the responsibilities below adopted from the head start of Lane County 1995-2013.

The indoor and outdoor spaces will provide safe physical environments that are conducive for the different stages of development of each child. Appropriate space and materials will be provided to conduct a variety of activities that promote development in each developmental domain (Ata, Deniz & Akman, 2012). The physical environment supports positive behaviours. Firstly, the manager should conduct a safety inspection to ensure that indoor, outdoor spaces and other physical arrangements are consistent with the health, safety and developmental needs of children.

Secondly, the manager should adapt and modify space to meet the needs of all children (Tadjic, Martinec & Farago, 2015). It is critical to also consider the needs of children who are physically and/ or sensory challenged. The manager should establish traffic patterns for entering the room, moving to and from activity areas. This can be done by minimising large open spaces and obstacles. One important role of the manager is to organise the room so that he/she can see as much as possible from every location to ensure children's safety (Tadjic, Martine, & Farago, 2015). In addition, the manager must provide individual spaces for each child to place their things. The things should be labelled using the child's home language.

Underscoring to the roles of the centre manager, Hoadley, Christie and Ward (2009), Hujala et al. (2016), Moen and Granrustern (2013), Modise (2019) and Shaw (2010), indicated that the manager among other roles should create, implement and sustain a quality child-centred environment. These authors further state that the role of a centre manager amongst others are to establish and maintain strong interpersonal relationships with staff, parents and children. They further mention that centre managers are to guide, mentor and continuously develop the knowledge and skills of staff; manage day-to-day managerial and administrative duties, including human resources and finances.

Centre managers according to the authors mentioned above make allusion that they are responsible for strategic functions such as goal-setting and quality improvement, and collaborating with community partners and setting up workable systems. They lastly agree that centre managers' roles is to provide leadership and management that shapes the educational institution; supervise curriculum coverage and assessment through instructional leadership. They are expected to also support educators in effectively implementing the cycle of planning to enhance programmes and practices.

According to Van der Berg et al. (2011), some ECCMs perceive their function as predominantly administrative and managerial; thus neglecting their role and responsibility of being an instructional leader and support for teachers to deliver the curriculum within a conducive DAPE. Furthermore, some leaders spent most of their time attending meetings, securing funds and donations, and buying groceries and supplies. An attitude adjustment and change in priorities are required to fit the notion of pedagogical leadership (Coughlin & Baird, 2013).

Understanding How Young Children Learn and Develop

Another component of pedagogical leadership, is that centre managers understand how young children learn, grow and develop in the first three years of their life (National Occupational Standards); thus they intentionally align content coverage and the DAPE with the guidelines Early Learning Development Standards (ELDS) (DBE, 2015). For the lasting holistic development of young children, it is significant for centre managers to encourage the development of age-appropriate milieus that have a long-lasting influence on children. In light of the list of roles and responsibilities for centre managers, educational researchers have delineated characteristics that DAPE should reflect.

While the issue of access to education can never be doubted, the importance of the physical environment in the provision of quality ECD education can also never be underestimated for it happens to be at the centre of the provision of a sound education. Stressing the importance of the physical environment in the provision of education, Sidhu (2000) argues that children cannot get the desired benefits from school if they are not housed properly, if they have no playgrounds, if they are taught in unhealthy surroundings and if the entire equipment provided to them is uncomfortable.

The ECCM, as a pedagogical leader with specialised knowledge and astute skills, has to provide an educational environment that: adheres to the health and safety regulations for constructing both indoor and outdoor environments. ECCM should have clear conceptualisation of the different stages of child development and capabilities, which will inform the provision of appropriate resources. The environment should allow children to explore the physical world with independence through play and experimentation.

According to Doctoroff (2001), Gordon and Browne (2017), NAEYC (2021), Nelson (2012), Van Heerden and Du Preez (2020), the manager should arrange safe indoor and outdoor areas for play, and nurturing spaces that support the emotional-social development of young children. Planning a place for children's growth and development becomes critical, managers need to consider physical elements, temporal dimensions, and the interpersonal atmosphere. Centre managers should promote play activities especially development complex play for all children through regulating group size and child-teacher ratio based on space organisation and material used in the classroom.

Creating Opportunities for Professional Development of Teachers

Mestry (2017), emphasises that centre managers are responsible for creating opportunities for teachers to continue with their professional development programmes to improve their practices and remain relevant and useful to the young child by adhering to the training requirements of the South African Council for Educators (SACE). In-service teachers need to be encouraged to equip themselves to become innovative towards developing recyclable resources to facilitate the active engagement of children in their physical environment. It is the researcher's view that the centre manager should encourage other staff members to engage in professional development as well. The innovative side of a centre manager will come to play when sharing their own experiences as young children with teachers of creating own resources than relying on bought resources. It becomes apparent that upskilling and sharing of best practices are of great significance in the early childhood education sector.

The Research Aim, Question and Objective

This research purposed to explore the role of Early Childhood Managers in promoting the developmentally appropriate physical environment in early childhood centres.

This research therefore aimed at answering the research question below:

What are the perceptions of ECCMs regarding their role in promoting DAPE for children aged birth to four years?

To answer the research question the following objective below needed to be achieved:

- to explore the perceptions of early childhood Center managers' role in promoting a developmentally appropriate physical environment.

Theoretical Framework

For analysis and interpretation of data, the study used the Role Theory of the American sociologist Robert Merton (1957). The common notion of the theory is that roles are associated with social positions (or statuses), Biddle (2013). A social position generally is an identity that designates a commonly recognised set of persons. Merton (1957) believed that everyday activity or behaviour can be socially defined according to categories. Daily, humans exhibit social roles which differ in nature, for example, rights, duties, expectations, norms, whilst others are behaviours one has to face and fulfil. Each social role carries both benefits as well as risks. Biddle (2013: 8) defines Role Theory as:

> *"A science concerned with the study of behaviours that are characteristic of persons within the context and with various processes that presumably produce, explain or are affected by those behaviours."*

The theory argues that each individual has a role to play in society which is informed by social norms; one's behaviour within this social role reflects whether his/she confirms or rebels against role norms or expectations; depending on individual characteristics, historical time, and cultural context; social roles can be rendered or changed by society establishing a new norm for prosocial behaviour which is rewarded or punished (Biddle, 2013; Hunter, 2001).

For this inquiry, an understanding was framed by the Role Theory when exploring centre managers' roles and responsibilities towards developing DAPE which adheres to predetermined standards and expectations set by the government and the society schooling serves. This theoretical framework guided an interpretation of how perceptions are shaped at school, formal and organisational levels; thus including all role-players from staff to policy-makers set government. The early childhood leader's central role expectation is goal-achievement of their centres

Method

Research Design

Empirical evidence for this investigation was generated using a qualitative research design with a case-study approach implemented from an interpretative paradigm. As Hennink, Hutter and Bailey (2020), explains, the most distinctive feature of qualitative research is that the approach allows you to identify issues from the perspectives of your participants and understand the meanings and interpretations that they give to behaviour, events or objects. Thus, the researcher wanted to obtain a rich and clear understanding of ECCMs' experiences, constraints and enablers, when promoting DAPE.

Participants

The research sites (cases) and their directly associated population were purposefully sampled. Five early childhood centres from the rural community of Gauteng North District were selected. The selected ECE centres had to meet the following criteria to be included in the research: they should be accommodating birth-to-four-year-old children, come from low-income socioeconomic areas within marginalised rural communities of Gauteng, the centre should be registered with the Department of Social Development (DSD) and Education – Gauteng North District. Participants were purposefully sampled with the following criteria taken into consideration: should be ECCMs with more than five years teaching experience in the rural areas of Gauteng Province, the ECCM being the founder, owner and functioning as both the teacher and the principal.

Upon identifying the most suitable manager-participants, the researcher discussed the purpose of the study with them to obtain informed consent and voluntary participation. The professional and qualification profiles of the respective participants are summarised and presented in table 2 below:

Table 1.

Demographic Details of Participants and Their Pseudonyms

Respondents	Age	Seniority	Education Level	Further study
Site-manager A	58	22	Diploma in Grade R	Honours
Site-manager B	58	23	Diploma in Grade R	No
Site-manager C	35	10	Diploma in Grade R	No
Site-manager D	53	27	Level 5 ECD	Diploma in Grade R
Site-manager E	32	12	Diploma in Grade R	No

Data Generation

To explore the complex social roles that ECCMs have, semi-structured interviews and high-quality pictures were utilised as a medium to capture their perceptions textually and visually. The semi-structured interviews further allowed

the researcher to establish participants' (ECCMs) perceptions regarding their experiences relating to their research topic (McIntosh & Morse, 2015). High-quality pictures of the physical environment were also taken and supplemented with observations of how the physical learning spaces were arranged and resourced. A narrative interpretation of pictures

Data Analysis

To make meaning of the generated data and to gain a comprehensive understanding of the phenomenon, the interview data-sets were transcribed verbatim and supplemented with printed pictures and additional observation notes before analysis. The thematic analysis enabled the researcher to identify patterns of meaning across data-sets that provided some insight on how to potentially answer the research question. The process of identifying patterns and themes was rigorously performed using data familiarisation; search for emerging patterns; data-coding; and data reduction by categorising evidence in distinct themes.

Table 2.

Aerial View of Indoor and Outdoor Physical Spaces at Some Selected ECD Sites

Observation notes and pictures	
Bedroom: Birth to one year	Classroom: Two to four years
	
• This room has feeding bottles and baby cots.	• Two to three years olds classroom with an assistant teacher.
Nappy changing station	Outdoor play area
	
• A separate demarcated room for nappy changing.	• Sheltered and unsheltered outdoor play area.

The table above show the pictures of how physical indoor and outdoor spaces for the young children has been arranged in some selected ECD centres.

Observation Notes and Pictures

Pictures of the indoor classroom and outdoor environments were taken and their analysis was presented together with the emerged themes and the questions asked. Pictures were labelled one to four. Picture one presented birth to a one-year sleeping area. This room had noticeable features of the age group. Feeding bottles were placed on the shelves. However, the baby cots did not have any hanging raddle making toys. Picture two was a classroom representation of birth to four years old children. Two to three-year-olds classroom was used for theme discussions, the size of the class was too small for individual space of each child. There were also two adults in the classroom, the teacher and the assistant.

The third picture was a separated nappy changing room with no visible toys or equipment to keep the child busy or make nappy changing exciting for the child. The bed was made of a wooden door – which made the researcher question the comfort of such a bed for the children. The fourth and last picture is the sheltered and unsheltered outdoor play area. The space looked very neat and clean without any play equipment for children to access freely at any time. Toys are brought out when children are outside otherwise they are being packed away after free play. Looking

at the unsheltered play area, resources or play equipment were readily available and it was noted that they were one size fit all. These results indicate that the centres are impaired by a lack of adequate standard physical environment.

In the subsequent paragraph, the researcher presents the related semi-structured interview questions, data coding and emerged sub-themes.

Question 1: *What is your understanding of the role and responsibilities of an early childhood centre leader?*
Data coding and sub-themes: Overall safety of the centre, Inspect teachers' preparations
Day-to-day operations of the centre.

Question 2: *According to your understanding, what does an effective teaching and learning environment entail?*
Data coding and emerged sub-themes: Inviting, clean and well-prepared environment, Age-appropriate equipment and information, Safety and functionality of resources, Age-appropriate equipment and materials, safe and trusting environment.

Question 3: *Which documents/policies guide your daily practices and implementation of the curriculum?*
Data coding and emerged sub-themes: Policy documents for Grade R education
National Curriculum Framework (CAPS) that is prescribed for Grade R.

Question 4: *How do you ensure that favourable environments for children are created?*
Data coding and emerged sub-themes: Mentoring one another, Design own educational toys, Community and parental involvement. Affordable commercial resources, Friendly environment, safety, loving and caring.

Table 3.
Emerging Themes from the Research

Themes	
Theme 1	Centre managers' central focus
Theme 2	Physical educational environment
Theme 3	Government involvement
Theme 4	Devising educational services

Results and Discussion

Based on the textual and visual information, the researcher has come to realise that the participants and the researcher may not share the same conceptual or scholarly understanding of what roles and responsibilities mean to promote DAPE for the very young child. The evidence of the four emerging themes (see table 3) will now be interpreted using the theoretical framework as a guiding principle. To increase the transparency, trustworthiness and credibility of the findings, the origin of the quotation is added in brackets. For clarity, abbreviation SM-A, SSI: Q1 stands for ECCM from research site A, semi-structured interview: Question

Theme 1. Centre Managers' Central Focus

The roles and responsibilities of an early childhood centre manager as discussed in the literature review consists of diverse tasks that range from pedagogical leadership, managerial and administrative tasks, and creating a DAPE to name a few (Hujala & Eskelinen, 2013, Shaw, 2010). Some of these tasks require daily attention, others weekly or monthly. The five respective participants, each representing their institution, shared their daily routine in terms of roles and responsibilities during the semi-structured interviews. As an observing researcher to understand the daily functioning of the centre manager, the researcher decided to present each participant's verbatim response sequentially using an overarching heading to get an idea of their day-to-day tasks. From a role theory perspective (Hunter, 2001), the set of normative expectations that defines a position (centre manager) or status (authority) in the social structure (education) influences their corresponding roles, behaviours and interaction with others that share this communal environment. From the illustration below (figure 1), it seems that the typical day for two participants is to ensure their early childhood centre "runs smoothly", inspecting the premises and interacting with staff, parents and children. It seems the task of ensuring safety indoors and outdoors is highly valued and to inspect curriculum coverage. One participant only expressed his/her concern about proper behaviour whilst another participant also elaborated on various other tasks that overlap with what scholarly literature summarises.

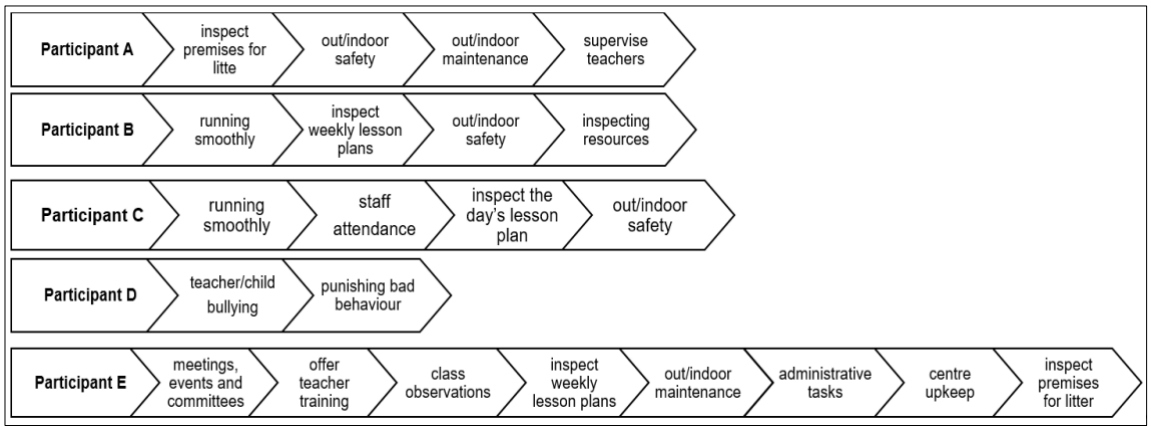

Figure 1.

Sequential Summary of Roles and Responsibilities

Theme 2. Physical Educational Environment

The physical educational environments for children must be intentionally developed to meet the emerging and current developmental needs of the 0-4-year-old children whilst keeping in mind the appropriateness and safety of the space and furniture. From a Role Theory point of view, the centre manager should understand that the young child and the teacher's wellbeing is of importance, thus connection and access to resources can promote feelings of security and directions for behaviour (Aarsten & Hansen, 2019). Each of the participants described a DAPE in extensive detail and most of their descriptions accurately reflect the body of scholarship on this topic. The quote from site-manager D reads as follows:

> *"… a developmentally appropriate physical environment comprises of a learning environment consisting of the following classrooms, Indoor play area, outdoor play area with age-appropriate equipment like, Jungle gyms, balls, scooters etc. that are small."*

The expression of site-manager E is:

> *"I prefer a spacious outdoor playground with various equipment: jungle gyms, sandpits, swings, see-saws, balls, tyres, bicycles, tricycles, and water-toys."*

The above verbatim expressions by the two centre managers concur. They both clearly articulated what a developmentally appropriate physical environment entails.

Theme 3. Governmental Involvement

The vision for early childhood education is to work with and for children respectfully and appropriately that provides them with quality experiences and equality of opportunities to reach their full potential (DBE, 2015). Regarding the early learning development areas, education for the young child should promote their: well-being, identity and belonging, communication, creativity to explore knowledge to understand the world. According to Rosen and Poage (2021), the National Association for the Education of Young Children (NAEYC) defined methods to promote the optimal development and learning of children through a strengths-based, play-based approach to joyful, engaged learning.

Considering from a role theory standpoint, authorities (social and education policy-makers) should offer social agents (centre managers) with official guidelines on how to ensure children receive appropriate and quality education (Hunter, 2001). Thus, the centre manager serves as a connecting link between government and society to equip future child citizens with knowledge, skills and values to function in society. Centre managers' knowledge of policies, white papers and the curriculum framework is imperative. This is clearly articulated in the National Occupational Standards NQF Level 5.

Each participant was allowed to share their experiences of an official government document and how they utilise them to inform their roles and responsibilities. Four of the five respondents referred to official policy documents for recruitment, finances and curriculum. Two participants indicated that they utilise additional curricula frameworks seeing that the national curriculum statement is intended for Grade R children and not the very young child (DBE, 2012). One participant expressed: "I use none. It's general knowledge" (SM-A). Probing further on their awareness that the CAPS (2011) do not cater for the educational needs of the children, not one of them was aware of the National Early Learning Development and Standards (NELDS) as an alternative curriculum-related policy nor the Early Learning Development Standards (ELDS) as an umbrella to plan experiences for children's holistic development.

Theme 4. Devising Educational Resources

Learning and teaching support materials are used in classrooms and are especially helpful for young children who require ample sensory input (Van Heerden & Du Preez, 2020). This equipment, media, material or resources are integral to all education systems and should be managed, utilised and maintained to ensure access and support to the delivery of quality education. In poor socio-economic communities, the Department of Social Development (DSD), serves as the main provider of ECE funds for purchases. To get the funds ECE centres need to register with the DSD and meet the set criteria. For ECE centres to register with the DSD requires compliance with a set of stringent norms and standards which are impossible to achieve for many centres, particularly those serving poor and rural communities (Giese & Budlender 2011). This process then leaves centre managers to find additional donations from various sources.

Role Theory emphasises that the interaction of social systems should be aimed at keeping relationships healthy to promote wellbeing, thus sharing resources promotes a sense of belonging (Aarsten & Hansen, 2019). Parents and members from the wider community serve a crucial role in creating and sharing educational resources. Some of the experiences shared by centre managers read as follow: "Every Monday we sit together to mentor each other about the environment. We also involve parents to provide us with recyclable materials." (SM-A, SSI: Q4-Q5), like: "parents bringing all sorts of empty boxes, plastic bottles, and other things to help make kids' resources useful for learning" (SM-E, SSI: Q4-Q5). An elaborative explanation was shared by the participant from research site C:

> *"Most of the time we create our resources, sometimes we buy. We involve the kids in developing the resources and sometimes some teachers are involved, most parents donate money. Every month the Department of Social Development gives us money to buy toys and other resources. If we do not get funds, as ECD teachers we create our own toys."*

Conclusion

Drawing from the data sets it seems that centre managers have a good understanding of their roles and responsibilities about certain categories of duties, whilst other expertise is seriously neglected and questioned. Concerning the photographs and the interview discussion, some of the following disparities can be highlighted. There is an understanding of what defines a developmentally appropriate physical environment for the Grade R child; however, not for the birth to four -year old children. Awareness of a lack of resources in rural areas and that ECE centres rely on donations or assistance from outside. Some participants were not very keen about carrying out their responsibility in creating DAPE themselves as experts; rather this responsibility is hastily outsourced to parents and members from the community who do not know very young children and what their learning needs are. Obliviousness notion presents that the Grade R curriculum can be adapted to serve the needs of babies and toddlers. Limited knowledge of the specialised curriculum needed to plan for holistic education of the very young children as catered for by developmental standards. Illiteracy of official government policies that prescribe educational, managerial, administrative and human resource practices at the school level. Inattentiveness towards providing continuous professional development of staff and teachers regularly. These findings contrast the competencies laid down in NQF Level 5. Preoccupation among participants about administrative and managerial obligations as opposed to pedagogical leadership, which focuses on quality and holistic education that inspires children to self-discover, solve problems to gradually become more independent.

Well-prepared early childhood environments should aim at developing the child in totality. It, therefore, challenges the centre managers to create environments that are developmentally appropriate with age-appropriate resources that cater for the educational uplifting of the children. Although teachers are also responsible, they do need support from leaders and other stakeholders. Parents, as some of the stakeholders, could contribute by helping to develop resources for their children, including volunteering their services at the ECE centre which will help in relieving the duty-load of staff members. However, it remains the duty of the centre manager to take the leading role as an expert in ensuring that physical environments are well-arranged and appropriately resourced. Their leadership and expertise should be evident in the way environments are arranged, managed and used to implement curricular goals and objectives.

Recommendations

Recommendations for Applicants

This study offers empirical data on how early childhood education centre managers within rural areas in the Northern Gauteng district may perceive their roles and responsibilities towards promoting DAPE. The data sets once again offer evidence that our childhood centres for the very young children require urgent support and dedication from the government, social development, early childhood leaders, policymakers, trainers and Non-Governmental Organisations (NGOs) to capacitate them with knowledge, skills, values and tools on how to: (a) give equal and quality

attention to each domain associated with being a centre manager, (b) develop, maintain and sustain DAPEs for the very young child, and (c) implementing a style of leadership that will be engendered to bring about meaningful change in their centres.

For example, the researcher dealing with policy documents noted that most of the time some of the early childhood centre managers do not acquaint themselves with existing policies but they rather pass them on to their subordinates without mediating, monitoring implementation, and supporting the guiding principles offered in the policy. It has become evident that early childhood centre managers are not aware of the other policy document that is of much relevance and significance to guide ECE teachers to uplift children's interest and performance in indoor and outdoor activities. Although this policy is not prescriptive, it does guide if one struggles with what needs to be done when dealing with birth-to-four year children at their centre. Knowledge and understanding of relevant policies play an important part in facilitating a productive ECE environment. Accordingly, leaders have to be aware of the existence of policies relevant to their sectors to dissect them for an incisive understanding to transfer relevant aspects of the document to practitioners so that they keep abreast with modern developments and strategies. They also need to keep referring to the norms and standards for providing active learning for early childhood children. This will compel them to ensure that active learning takes place effectively and efficiently in a developmentally appropriate physical environment.

The findings, through interviews, revealed very limited knowledge and understanding of a centre manager's role that would set apart their responsibility from those of the teachers. Leadership is about facilitating meaningful positive change that helps followers to contribute holistically towards the enhancement of the institution. Hence, ECE leaders should be influential in making meaningful contributions by exposing children to physical environments that are developmentally appropriate. Thus, early childhood centre managers need to rethink their roles and responsibilities as leaders, in line with the National Occupational Standards NQF Level 5, mandatory competencies.

They must be transformational-minded and constantly monitor and evaluate their school situations which will elicit an appropriate leadership style that would benefit all role-players and enable them to resolve a variety of socio-economic, political and environmental challenges encountered within and around their centres. Pedagogical and transformational leadership styles are among those that are advantageous to upgrade the quality of ECE environments. This will require them to be fully involved in transforming their physical environment which will cater for all children of different ages at their centres. The findings also revealed that some resources provided in ECE physical environments were inappropriate; even the set-up of the environments lacked meeting the required standards. For example, the outdoor area had resources inappropriate for birth-to-four-year-old children, but rather for older children. Leaders at ECE centres must take full control of their leadership role in providing and resourcing developmentally appropriate physical environments.

Planning, designing, and structuring indoor and outdoor areas have a great influence on how children behave and feel. In this regard, the physical environment should be well-organised, comfortable, and welcoming to offer a variety of activities for cognitive, social, emotional, and physical development. Although centre managers remain the primary implementation agents for DAPE, they are often incapable of executing this function. This paper explored the reasons for this incompetency and recommends urgent intervention. It was established that educators needed to be provided with the training and guidance necessary to promote the holistic development of the child by using DAPE strategies. Outcomes presented in this paper have implications for policy and practice more so with the function shift of birth to four-year-olds from DSD to DBE. They offer insight into the context of the ECCMs understanding of their roles in promoting developmentally appropriate physical environments to children.

Limitations of Study

The study limitation factors are stated below:

- The study was limited to only one province while South Africa has nine Provinces.
- Gauteng Department of Education has fifteen (15) districts servicing the schools and community based Early childhood centres and the study was only limited to one district, with data collected from only five community-based centres.

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Research Article

We need to make up for the gap: University student teachers' difficulties associated with basic algebraic manipulations

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Abstract

It is irrefutable that preparing successful mathematics teachers is a complex task, marked by a convergence of studies in content knowledge and instructional technologies. Considering the increasing number of students enrolling in South African teacher training institutions, it is essential to determine what mathematical knowledge gaps and understanding they bring from secondary school level for the purpose of configuring best strategies to prepare them to become effective teachers. This is the context for a study of first year undergraduate mathematics education students at the University of Limpopo. In this paper, we present our autoethnographical experiences of lecturing calculus courses for a teacher preparation programme. In this paper, we use autoethnography reflexivity to illustrate intersections between self and university society, the particular and the general, the personal and the politics of mathematical knowledge. The patterns that emerged from our interactions with students revealed that they experienced difficulties in understanding basic algebraic procedures and recognising structure to solve algebraic problems in the context of differentiation. This made us aware that we needed to configure effective strategies to make up for the identified elementary mathematics knowledge gaps, which we assumed students brought with from Grade 12. Our quest to make up for the algebraic knowledge gaps does not only serve the purpose of enabling our student teachers' mathematical knowledge, but to ensure that they develop good knowledge base needed to teach the subject during their training as well as once they qualify as teachers.

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Introduction

It is understandable that mathematics teacher preparation programmes characteristically includes the study of content knowledge and pedagogical knowledge that enables learners' epistemological access to mathematics content. With this in mind, it is important to note that South African universities have students from diverse schooling contexts, geographically, culturally and academically. Accordingly, it is our responsibility as teacher educators, to critically evaluate prospective teachers' background knowledge of mathematics. This is one way of gaining insight into the quality of students' mathematics understanding, to help us identify possible gaps in their content knowledge in order to configure strategies to address such gaps and ensure that we produce effective teachers. Wasserman (2018) suggests that the secondary school mathematics should inform how mathematics for teacher preparation programmes are structured and taught. In this vein, our concern is that prospective teachers enter the university system with content and procedural knowledge gaps from secondary school which we need to make up for in our programmes.

According to Wood and Solomonides (2008), it is essential to focus on preparing prospective teachers for the profession, rather than focusing on the mathematics difficulties they had in secondary school. While focusing on

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helping students develop their professional and mathematical identities is important, as teacher educators, we cannot simply ignore the knowledge gaps that students come to university with, as this plays a significant role in their learning in mathematics undergraduate courses. Speer et al. (2015) states that "evidence suggests that prospective high school mathematics teachers, who earn a mathematics major or its equivalent, do not have sufficiently deep understanding of the mathematics of the high school curriculum" (Speer et al. 2015, p. 107). One reason for this could be the oversight teacher educators make in understanding and working with students' level of content relating to secondary school curriculum. This paper focuses on illuminating some of the prospective teachers' knowledge gaps in understanding what we consider to be basic algebraic procedures, which from our experiences constrain their more abstract thinking and learning of the topics in our mathematics teacher preparation programmes.

Literature Review

Prospective teachers' limited understanding of mathematical concepts and procedures is extensively documented in various previous research studies (Ryan & Williams, 2011; Anthony et al. 2012; Tunç & Durmuş, 2012; Askew, Bowie & Venkat, 2019). The absence of preservice mathematics teachers' mathematical content knowledge absence has been described in terms of conceptual flaws that students make, mistakes in mathematics conventions as well as inappropriate computation and application of mathematical procedures (Amador et al. 2017; Putra & Winsløw, 2018). In our case, we have observed that pre-service mathematics teachers' content knowledge absence relating to algebraic rules constrain their use of mathematical contents they learn in undergraduate courses to answer questions, especially in cases where such content directly required them to draw from the secondary school mathematics we assumed they had. The prospective teachers' observed difficulties during lectures in our teacher education programmes provided us with information from which we can reinforce inferences in literature relating to prospective teachers' limited foundational mathematical content knowledge, which is required for further learning at university. We use the term foundational mathematics content to refer to mathematical content that the students are expected to come to university with from secondary school and should be able to demonstrate in teacher education programmes.

Within the concept of prospective teachers' mathematical content knowledge, both the importance of understanding students' misconceptions and errors and difficulties in engaging with mathematical thinking and processes have been documented in a number of studies (Koç & Bozkurt, 2011; Tunç & Durmuş, 2012). While this is the case, within the context of South African public universities, there are limited studies that offered insights into teacher educators' experiences of working with pre-service mathematics teachers who demonstrate conceptual flaws, mistakes in mathematics computations and/or apply mathematical procedures incorrectly (Ndlovu et al. 2017; Adendorff et al. 2019). We believe that teacher educators' reflections on students' errors or misconceptions they observe during lectures could help us understand different ways of thinking and knowing about undergraduate students' mathematical content knowledge absences and subsequently how such absences could be adequately addressed in initial teacher education programmes. This is vested on the idea that teachers' mathematical content knowledge is developed during their training and before, thus teacher educators are better positioned to critically evaluate and understand pre-service teachers' levels of conceptual and procedural knowledge for the purpose of bridging the gaps before students graduate.

Theoretical Framework

In this paper, we use social practice theory as a theoretical lens to critically analyse and understand pre-service mathematics teachers' limited understanding of foundational mathematical concepts and procedures in our initial teacher education programmes. The social practice theory foregrounds the idea that students' errors and difficulties in learning are inherently part of the teaching and learning processes, for both experienced and apprentice in a particular field or practice (Yackel & Cobb, 1996; Bell et al. 2012; Brodie, 2013). Within the social practice position, reflections and conversations about the errors and content absences students demonstrate while solving mathematical problems are essential for creating ways of thinking about the practice and the mathematics education community. Students' errors and difficulties in computing mathematical procedures during teaching and learning provides opportunities to establish the criteria to foreground what counts as "…valid or invalid production mathematically" (Brodie, 2013, p. 224). In our case, we consider the conversations we had with the students during lectures to be significant in supporting pre-service teachers to develop correct conceptual and procedural understanding, of the knowledge they are supposed to bring with to university.

In our critical analysis of our prospective mathematics teachers' errors and content absences in their procedures while solving mathematical problems, we employ three principles of social practice theory to create meanings and educational knowledge (Holland & Lave, 2009; Brodie, 2013). The first principle emphasises the idea that students' errors and lack of understanding are sensible and reveal (mathematical) thinking among students. Secondly, students'

mathematical errors and absences in their foundational content are typical and integral part of mathematics learning, especially considering that our pre-service teachers come from predominantly rural schools, which are reported to have sub-standard mathematics teaching (Spaull, 2013; Masinire, 2015; Mbhiza, 2021). Thirdly, students' mathematical errors and content absences in their mathematisation processes give educators access and understanding of current students' thinking as well as their current ways of doing mathematics. In the context of understanding and problematizing prospective teachers' foundational content knowledge during lectures, this last principle gives us access to possibilities for future development in their mathematical thinking and procedural fluency when they qualify as mathematics teachers. In the current paper, we offer dense descriptions of what we learned about prospective mathematics teachers' errors and content knowledge absences relating to basic knowledge of algebra, which is typically knowledge students should know and own from secondary school. In the following section we present the methodological approach we espoused in this paper and how the approach enabled us to evaluate and illuminate various errors and absences in students' foundational content knowledge in our pre-service mathematics problems.

Methodology

An autoethnographic approach focuses on describing and systematically analysing personal experiences of authors for the purpose of sharing lived experiences (Ellis et al. 2011; Adams et al. 2017). In the current paper, we present and critically examine our experiences of teaching a mathematics education course at first year undergraduate level, to offer understanding of the patterns that emerged during lectures. We believe that the personal experiences in teaching mathematics education and preparing future mathematics teachers is an important source of knowledge in and of itself, as authors "look inward and outward, exposing a vulnerable self that is moved by and may move through, refract, and resist cultural interpretations" (Ellis, 2009, p. 10). In this paper, we use autoethnography reflexivity to demonstrate intersections between self and university society, the particular and the general, the personal and the politics of mathematics knowledge. We particularly reflect on and present our autoethnographical experiences related to the students' foundational mathematics knowledge gaps in our initial teacher educational programmes. As stated earlier, our students demonstrated conceptual and procedural knowledge gaps during lectures on different mathematics education topics. Accordingly, we use extracts from our debriefing reflections on our lectures, to illuminate critical incidences that revealed students' conceptual and procedural knowledge and understanding, positioning us as both insiders and outsiders in the system of observing our students' mathematical knowing and understanding (Boylorn, 2011; Cooper et al. 2017). In this paper, we articulate our insider experiences and knowledge of teaching prospective mathematics teachers who demonstrated limited understanding of mathematical procedures which we assumed to be foundational – knowledge we expected that they brought to university from earlier levels of schooling.

We believe that as writers, we can inform readers about aspects of mathematics education teaching that other researchers may not be able to understand and/or take for granted. As far as it can be determined, within the South African Higher Education context, there is a dearth of autoethnographical accounts of mathematics teacher educators' knowledge and experiences of lecturing prospective teachers. We argue that as mathematics teacher educators, we are best positioned to talk about prospective teachers' mathematical knowledge in ways different from others who do not have experiences with this aspect. While this is the case, "Insider knowledge does not suggest that an autoethnographer can articulate more truthful or more accurate knowledge as compared to outsiders, but rather that as authors we can tell our stories in novel ways when compared to how others may be able to tell them" (Adams et al. 2017, p. 3). For the purpose of this paper, to think with a story about prospective teachers' limited foundational knowledge is to experience such knowledge gaps affecting our teaching as teacher educators and to find in that effect particular truths of our lives as mathematics education lecturers.

Data Collection and Analysis in Autoethnography

Previous studies that used autoethnography (Adams, 2011; Duncan, 2004; Gobo, 2008; Pelias, 2011) have suggested the need for 'hard' evidence to support 'soft' impressions, and to generate interpretations and make claims about personal experiences. In this paper, we present our experiences of teaching mathematics education at undergraduate level as stories to offer insight into the patterned processes in our interactions with students, and into the knowledge gaps they demonstrated during teaching and learning. We use extracts of the errors students made during lectures and reflective lectures discussions as our data. We analysed and re-analysed the observed errors students made during learning and the notes from the lectures that we individually wrote and discussed together using thematic content analysis and using the processes of 're-memory' to identify commonalities and differences in students' difficulties associated with algebraic rules.

Ethical Consideration

In writing about subjective experiences of a particular phenomenon, Ellis (2009, 42) cautions that, "autoethnographic stories of our experiences, are not wholly our own; they implicate relational others in our lives". This statement addresses the core essence of relational ethics, which obliges researchers to make ethical considerations when speaking about others in our stories, in this paper, prospective teachers in our initial teacher prapation programme. To ensure protection of our students' identities, even though we talk about them in describing and discussing our experiences, we do not mention any identifying information throughout the paper. In this paper, we talk about our students as a group to ensure that we conceal their true identities. The rationale for this is vested in Tullis' (2013) argument that as autoethnographers, we should earnestly consider our "responsibilities to intimate others who are characters in the stories we tell about our lives" (p. 4). Thus, in the descriptions and discussions of our our experiences and observations of our students' foundational knowledge gaps for mathematics, we conceal their true identities through writing about the students as a group.

Narratives and Discussion

Prospective teachers are expected to have prompt recall of the elementary mathematics facts of addition, multiplication, division and subtraction in order to solve mathematical problems in initial teacher education courses purposefully and effectively. Our autoethnographies will demonstrate that the prospective mathematics teachers in our programme do not understand mathematical ideas and procedures that we consider to be basic to mathematics education courses. That is, we have experienced that the students do not possses the skills to engage in algebraic manipulative processes of even secondary mathematics, and in-turn this constrain their learning of new ideas. In this section, we critically present our autoethnographical experiences of working with prospective mathematics teachers' limited knowledge of the abovementioned basic facts during lectures on differentiation.

Simplifying Powers and Fractions as They Learn Rules of Differentiation

This section focuses on how prospective teachers are fraught by a lack of essential technical mathematics facility, in particular a lack of procedural fluency in algebraic simplification and manipulations during lectures on the rules of differentiation. The first critical incident that we have selected to use to highlight students' severe lack of technical facility was when we asked prospective teachers to apply the procedures to differentiate the function $f(t) = \sqrt{t}(1 - t)$ and present the derivative in its simplest form. The question required the application of the combination of two rules of differentiation: Power Rule and Product Rule. The objective was to assess whether they would be able to apply the Product Rule given the context of the problem. We gave the students time to solve the problem independently and later invited them to verbalise the steps to finding the solution and the final answer. Given the limitations we have with blackboard we decided to share what we thought would be the answer to the question to the benefit of those who might have got it wrong. Below is what we shared during the synchronous session.

$$f'(t) = \sqrt{t}\frac{d}{dt}(1-t) + (1-t)\frac{d}{dt}\sqrt{t}$$
$$= \sqrt{t}(-1) + (1-t) \times \frac{1}{2}t^{-\frac{1}{2}}$$
$$= -\sqrt{t} + \frac{1-t}{2\sqrt{t}} = \frac{1-3t}{2\sqrt{t}}$$

According to Aguilar and Telese (2018, p.25), "Teacher-candidates need to experience and face the struggle of solving different types of problems, which develop, not only their mathematical concepts, but also their ability to address student solutions from different perspectives". Thus, we gave propspective teachers time to go through the solution and invited them to make sense of the mathematical concentions and ask questions where they did not understand as a way of allowing them to think about mathematical processes applied in the example. To our surprise, almost all the questions asked were on how we moved from $(1-t) \times \frac{1}{2}t^{-\frac{1}{2}}$ to $\frac{1-t}{2\sqrt{t}}$ and from $-\sqrt{t} + \frac{1-t}{2\sqrt{t}}$ to $\frac{1-3t}{2\sqrt{t}}$. We had assumed that the students would not struggle with the basic algebraic manipulations and calculations, but that they would have difficulties understanding the rule. That is, we did not expect students to lack elementary skills and knowledge for simplifying mathematical expressions. In view of this, the observed content absences during lectures gave us access and understanding of our students' mathematical thinking and difficulties, to help us configure preventative measures to help learners learn the procedures (Holland & Lave, 2009; Brodie, 2013).

The observed students' difficulties resonates with Sebsibe and Feza's (2020) iteration that, "Experiences and public evidence disclose that difficulties in calculus brought from grade 12 inhibit students' progress at university" (p. 2). In this regard, our students demonstrated two forms of elementary mathematics knowledge gaps or difficulties: rewriting powers using positive exponents and identifying a step where a sum of two fractions were simplified. At this level of studies, we often assume that our students are proficient with working with powers given the vast mathematical concepts that requires the application of laws of exponents in secondary school. Working with surds could also be a reason why they could not simplify the sum, thereby constraining their learning of abstract concept of differentiation. This was concerning for us, especially considering that the lesson had to shift from learning about the Product Rule and its application to simplifying powers, identifying the common denominator when adding fractions that involves variables, and working with surds, which are skills students should come with from Grade 12.

Our concern amplified when we noticed that the above was not an isolated case, as a similar observation was made when we introduced students to L'Hopital's Rule. In this instance, we asked prospective teachers to calculate $\lim_{x\to\infty} \frac{lnx}{\sqrt[3]{x}}$. After giving them time to try it out, we shared the solution depicted in image 1 below and invited them to have a look at it and comment on it.

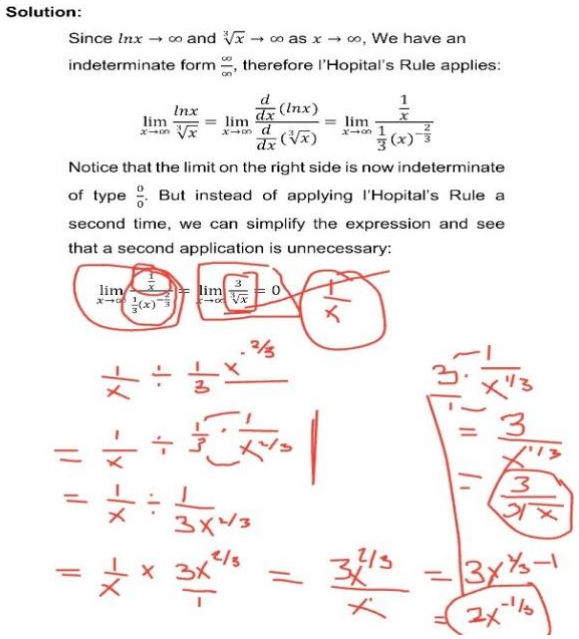

Image 1 .

Solution We Shared with the Students

Again, the questions that students asked were not on the application of L'Hopital's Rule, but on how we simplified $\frac{\frac{1}{x}}{\frac{1}{3}(x)^{-\frac{2}{3}}}$ to get $\frac{3}{\sqrt[3]{x}}$. Similar to the lesson on the Product Rule, the lesson's focus also moved from L'Hopital's Rule to focus on the calculation processes to simplify powers using positive exponents. The handwriting in image 1 was an attempt to explain the calculation processes. In relation to social practice theory, modelling this calculation processes to the students was essential in supporting the students to develop correct conceptual and procedural understanding, of the knowledge we iniallty thought they brought with to university (Brodie, 2013). This is the knowledge that we assume students come to university with and yet students fail, not because they do not understand high level mathematics, instead because they struggle with the algebraic manipulations that they should have mastered in their secondary school mathematics. Existing literature (Pillay, 2008; Maharaj, 2010; Siyepu, 2015), has also demonstrated that most students' knowledge gaps in algebraic manipulation skills from lower levels of schooling limits their performance in university mathematics.

Prospective Teachers' Mathematical Knowledge of Equivalence

Among one of the practices we conduct as lecturers of mathematics for educators modules is the study of prospective teachers' errors or difficulties that relate to their understanding of algebra, to ensure that we configure strategies to address the errors as we prepare them to become effective mathematics teachers. When differentiating composites of transcendental functions, we noticed that students saw equivalence in cases where it did not exist. This was more evident in composite functions for which the differentiation of the inner functions involved a product rule. When determining the derivative of $f(x) = e^{x\sin x}$, among the answers we found was:

$$\frac{d}{dx}\, e^{x\sin x} = e^{x\sin x} \cdot x\cos x + \sin x \cdot 1$$

While it can be argued that the mathematics prospective teachers have learned at this level was not a problem, the same could not be said for the algebra learned in high school. It can be claimed that prospective teachers were aware that they had to multiply the derivative of the outer function by the derivative of the inner function. But the student teachers faced difficulties in using an algebraic procedure that involved multiplication of a factor $e^{x\sin x}$ by a binomial $x\cos x + \sin x$ effectively. As part of the procedure, the brackets should have been used to show that in this case, as the binomial is a compound factor. In the absence of the brackets, we argue that the prospective teachers failed to realise that the product of $e^{x\sin x}$ and $x\cos x + \sin x$ is not $e^{x\sin x} \cdot x\cos x + \sin x$. In its basic form the structure of this multiplication is the same as $a(b+c) = ab + ac$. Rittle-Johnson et al. (2011, p. 2) states that "Understanding mathematical equivalence requires understanding that the values on either side of the equal sign are the same". Accordingly, our interpretation is that the students were unable to translate distributive law, to a different context within the mathematics domain, which is elementary computational manipulative. Knowledge of mathematical equivalence should be well developed when students enter university, as it is a prerequisite for learning higher level algebra effectively. Considering the importance of students' understanding of mathematical equivalence, it was concerning that students failed to notice the application of this concept.

A similar 'error' was made when students were asked to determine the derivative of $y = \ln(\cos x \tan 5x)$. Among the answers that were given is that

$$y' = \frac{1}{\cos x \tan 5x} \tan 5x \frac{d}{dx}\cos x + \cos x \frac{d}{dx}\tan 5x = \frac{-\sin x \tan 5x + 5\cos x \sec^2 5x}{\cos x \tan 5x}$$

This answer shows that the students were not aware that structurally $\frac{1}{\cos x \tan 5x} \tan 5x \frac{d}{dx}\cos x + \cos x \frac{d}{dx}\tan 5x$ and $\frac{-\sin x \tan 5x + 5\cos x \sec^2 5x}{\cos x \tan 5x}$ are not the same and therefore not equivalent. This lack can be linked to students' poor sense of mathematical structure. Structure sense in this instance is taken as an ability to "recognise which manipulations is possible to perform" (Hoch & Dreyfus, 2005, p. 51). Again in this case, the brackets should have been used to group the terms that formed the binomial so that the multiplying factor $\frac{1}{\cos x \tan 5x}$ could be multiplied with each term in the binomial. Thus, the students were not able to "recognise an algebraic expression or sentence as a previously met structure" (Hoch & Dreyfus, 2005, p. 51). Put differently, the students failed to recognise similar mathematical properties in different forms (Hawthorne, & Druken, 2019). In contrast to applying set of procedures automatically as discoraged by Hawthorne and Drunken, by applying the rules of logarithms, the function $y = \ln(\cos x \tan 5x)$ could have been written as its equivalent $y = \ln(\cos x) + \ln(\tan 5x)$ before finding its derivative.

In view of the above, we argue that the students lacked comparative relational thinking, which is a prerequisite for solving equations and evaluating structures of equations through comparing the expressions on both sides of the equal sign. To move beyond the mere *noticing* of the mathematics knowledge gaps in prospective teachers, such errors presents opportunities for us as teacher educators to configure effective teaching strategies to help remediate prospective teachers' basic algebraic knowledge and computational skills throughout the trajectory of training them to become effective mathematics teachers. This position resonates with the social practive theory's first principle, which advocates that students' errors and lack of understanding are sensible and reveal (mathematical) thinking among students, which in turn teachers can use as information when transforming knowledge for future lessons.

Conclusions

In this article, we have illustrated our experiences as mathematics education lecturers and researchers mathematics knowledge gaps that prospective teachers bring with to university from secondary school. To our knowledge, there is no study within the South African educational context that discusses the issues of undergraduate mathematics education students'knowledge gaps from personal experiences of lecturers. This article illustrates how the students' foundational mathematics knowledge gaps constrain their effective learning of algebra at undergraduate level from an insider perspective. We also call for research that unearth the lived experiences of mathematics education lecturers in other universities and contexts, to understand the nature of students' understanding of mathematics content and how their knowledge gaps shapes their learning of mathematics at undergraduate level.

Autoethnographical approach to writing and research bears critical implication to our professional learning as teacher educators. We have learned through this writing that autoethnographical reflections fosters selfawareness and knowledge about a field, as it helped us to identify students' algebraic knowledge gaps, rethink our instructional practices and configure strategies to facilitate their learning of mathematics. We therefore recommend that further research and writing explore how autoethnographical approach to writing and research may be incorporated regularly in university lecturers' professional development programmes.

Recommendations

In view of our experiences detailed above, we argue that observed prospective teachers' difficulties associated with elementary mathematical calculation skills could provide valuable learning opportunities for their learning, provided lecturers employ remediation strategies to address the knowledge gaps from Grade 12. Accordingly, it is important to assess students' foundational knowledge and configure preventive strategies to address observed difficulties and improve prospective teachers' level of conceptual knowledge. If the urgency of improving the standard of Mathematics Education in South Africa is seriously considered, addressing prospective teachers' knowledge of basic computational skills and sense of structure should given much attention in initial teacher education programmes. We recommend that basic algebraic skills should be infused in mathematics education content courses. Algebraic manipulation skills and structure noticing are crititical abilities to hone in mathematics, as such, prospective teachers should be given opportunities to develop and improve such skills to ensure that they become prepared to enable their own learners' epistemological access to mathematical knowledge.

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Research Article

Creating and leading a learning environment in diverse Foundation Phase classrooms in a South African school

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Abstract

Leaders and teachers are exploring ways to organise their learning spaces as well as their methods of teaching and learning. We aim to explore leaders and teachers' experiences of an invitational learning environment in culturally diverse Foundation Phase classrooms in the South African context. In this study, the Invitational Learning Theory was used as a theoretical framework. An interpretivist research paradigm was used to portray the lived experiences and personal responses of the participants. Interviews were undertaken with Foundation Phase teachers and School Management Team to elicit in-depth information on their experiences on the creation of a conducive learning environment. Additionally, observation and visual data formed the data collection instruments. Data were coded, examined and emerging themes identified. Findings highlighted the need to improve the '5Ps" as advocated by Novak and Purkey. The learning environment is a qualitative determiner for success. It is the responsibility of all stakeholders to ensure leadership for learning is conducive to teaching and learning.

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Introduction

One of the seminal changes that occurred with the advent of a democratic government was the change in the South African education system. The government-driven interventions have arguably been about ensuring that all learners have equal opportunities for quality education. According to Taylor (2003), a major challenge for the post -1994 government was to redress the inherited inequalities through social and educational reform. They also argued for the consideration of the creation of non-discriminatory school environments into which access was gained based on the rights of the child to education rather than on race, colour, creed or religion.

South Africa is characterised by its vast cultural diversity as it is unusual for a classroom to be filled with learners from only one cultural background. Children in most classrooms today come from a wide variety of backgrounds (Mistry & Sood, 2016); this situation is also prevalent in most South African schools. South African schools have an environment of learners from multicultural, multilingual backgrounds and social contexts (Smart, 2019). Ginsburg (2015) states that when a learning environment acknowledges social behaviour and recognises cultural awareness, learners can become 'knowledge builders', instead of 'knowledge resisters'.

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School leaders and teachers are exploring ways to organise their learning spaces as well as their methods of teaching and learning to accommodate all learners within a diverse school system. This paper aims to explore teachers' and school leaders' experiences of an invitational learning environment in a culturally diverse Foundation Phase classroom within the South African context.

South African classrooms are made up of learners from different cultural backgrounds, creating a classroom filled with cultural diversity; thus, requiring the teacher to become the agent of inclusivity. They are confronted with the idea of having to be conversant with the importance of culture in forming learner identity and creating a culturally responsive classroom atmosphere. Therefore, creating an invitational learning environment in a culturally diverse classroom is a multi-faceted and complex task. Achieving an inviting learning environment is fundamental to creating positive emotions towards learning, ensuring a more effective holistic development of learners, with improved academic results (Adelman & Taylor, 1997; Miller & Cunningham, 2011). Research by Haigh (2007) suggests that positive learning environments can improve educational experiences and that learning is enhanced when learners are positively encouraged or invited into the educational environment.

Explanation of an Invitational Learning Environment

Invitational Education is a learner-centred approach to the teaching and learning process. It is a theory of practice for communicating caring and appropriate messages to encourage individuals to achieve their full potential, including identifying and changing those forces in schools that would hamper or defeat potential and success (Hunter & Smith, 2007).

Purkey and Novak (1996) mentions that iinvitation education recognises five domains which include everyone and everything in a school environment. The domains include, people, places, policies, programs and processes. An invitational learning environment is created by school leaders and teachers to promote teaching and learning (Haigh, 2011). The five domains listed below exist in almost every environment that contribute to the success or failure of human endeavour (Purkey, 1991). These domains referred to as The five 'Powerful P's' directly impact and influence the behaviours and actions of every stakeholder (school leaders, teachers, learners government officials and non-governmental organisations) towards the successful creation of a leading and learning environment. The Powerful P's, according to Haigh (2011) creates an ecosystem in which the individual exists.. The table below gives an outline of each domain.

Table 1.

***The Five Ps Identified by Purke*People**	**Places**	**Policies**	**Programmes**	**Process**
Teachers and staff (both teaching and non-teaching).	Physical attributes of the classroom and school.	Written and unwritten rules regarding procedures. This includes policies on grading and discipline.	Curriculum and content for learners. This includes programmes of wellness and parent participation.	Examines how the other four Ps are conducted.

- People; people are an integral and important factor in creating and leading a learning environment. They play an important role in creating a respectful, optimistic, trusting and the intentional environment – in this instance the learning environment in a Foundation Phase class in a South African school.
- Place; places refer to the physical environment, the foundation phase classroom, offices, hallways, toilets, playing fields, library, etc all have an impact on how an individual feels within this environment. Purkey and Novak agree that making changes to the immediate physical environment offers an opportunity for improvement.
- Policies; refer to codes, rules or procedures either written or unwritten that is used to regulate the ongoing function of individuals in the school environment. These policies communicate a strong message regarding the value, ability and responsibilities of school leaders, teachers and learners.
- Programmes in a school maintain a wider scope of the needs of people by ensuring that programmes are monitored and achieve the goals for which they were designed without negatively labelling and stereotyping.
- Processes; focus on how the other four P's are conducted. How things are done and the atmosphere created (Purkey & Novak, 1996).

Each of the five Ps identify elements that school leaders and teachers are expected to respond to for successful invitational teaching and learning. The invitational theory seeks to explain the phenomena and provide a means of intentionally summoning people to realise their boundless potential in all areas of worthwhile human endeavour (Purkey & Siegel, 2013).

Invitation learning aims to make these domains intentionally inviting by encouraging teachers and school leaders to become active participants in creating a conducive learning environment. This invitation is measured through four levels: intentionally inviting, unintentionally inviting, intentionally disinviting and unintentionally disinviting and the five powerful 'Ps'. This paper will use the five powerful 'Ps' to measure the extent of the invitation to create and lead a learning environment in diverse Foundation Phase classrooms in a South African school (Purkey, 1999). The principles of the invitational theory that will be considered are respect for people and their differences, the trust expressed through cooperation and a sense of community as well as optimism regarding the learner's untapped potential and intentionality and the five Powerful 'Ps' (Haigh, 2011).

Creating and Leading a Learning Environment in a Diverse Classroom

The learning environment within a school is important in developing a healthy conducive atmosphere where education is easily attained. Mejia (2016) believes that the importance of school leaders in creating this environment is crucial to the success of invitational teaching and learning. School climate, according to Egwu (2015) is seen as a major determiner of classroom behaviour and learning; it describes the environment that affects the behaviours of teachers and learners. Adelman and Taylor (1997) agree that understanding how to establish and maintain a positive classroom climate is seen as a basic requirement to improving schools. School leaders and teachers represent the mechanism of change; and the tone of the classroom environment commences with the teacher. They are responsible to ensure that the school climate reflects the physical and psychological aspects of the school. School leaders must ensure that their schools embrace a positive appearance, form good relationships between teachers and learners, ensure responsible leadership and decision making, encourage the creation of a conducive learning environment, sustain a positive attitude and culture to encourage school-community relations and participation (Egwu, 2015).

Cross and Hong (2012) agree that school leaders play a decisive role in helping teachers to be happy at their jobs, supporting them in every aspect of curriculum implementation and management. Teachers who are unhappy or feel that they lack the support from school leaders tend to perform poorly and it reflects on their learners' learning (Michael, 2020). Researchers, Fernet et al. (2016) has found that dissatisfied teachers find their careers becoming a burden to them; however, when teachers are recognised, acknowledged and supported they tend to be intrinsically motivated. It must be noted that teachers who are satisfied with the decisions and the degree of support provided by their school leaders show a more positive attitude towards teaching (Cross & Hong, 2012). When teachers perceive and experience collaboration and cooperation from their school leaders they enjoy a sense of security and a feeling of belonging. Purkey and Novak (2015) state that a fundamental aspect of invitational education is understanding that human existence is a collaborative activity and all human beings are interdependent. A positive inviting relationship takes both time and effort to create a trustworthy pattern of interaction between the school leader and teacher. School leaders and teachers are likely to succeed when they make creating and supporting high-quality teaching their utmost priority in a diverse foundation phase class (Hunter & Smith, 2007). There is agreement that if school leaders know what needs to be done and doing it requires vision, resourcefulness, creativity and some humility, the possibility of invitational success is greater (Scribner et al. 2011). In her study, Mejia (2016) found that most school leaders adopted an inclusive leadership style to school management in promoting an inviting school climate. School leaders indicated that they made an effort to meet their staff frequently and allowed them the opportunity of contributing to the success of teaching and learning – this to them was empowering teachers to be part of the leadership action plan (Mejia, 2016; Egwu, 2015). Leaders also believed that to create a healthy environment for teachers and students it is important to make them feel comfortable and valuable. In an inviting environment, the school leader is a good listener, available to teachers, being responsive to their needs and having an open-door policy that encourages all teachers to be part of the success in the school (Mejia, 2016). Most people are able, valuable and responsible and should be treated accordingly. Purkey (1991) states that the success in a diverse foundation phase class is determined by mutual respect for all role-players. This respect and acknowledgement should be manifested in all aspects of places; policies, programmes and processes that exist within the school environment (Purkey & Novak, 1996). Snow et al. (2021) believe that constructive leaders act legitimately in the interest of the organisation (school), supporting and enhancing the goals, tasks and strategies of the organisation. They ensure that their staff is motivated, enjoy job satisfaction and engage in behaviours that are inviting, respectful, and intentionally working towards the common goal of ensuring successful teaching and learning (Fernet et al. 2016).

Theoretical Framework

A theoretical framework provides an overview of perspectives and research results regarding the proposed topic (Ferreira, 2012). For this paper, the Invitational Learning Theory was used as a theoretical framework. The Invitational Education Theory was developed by Purkey to create a total school environment that intentionally summons people in schools to realise their relatively boundless potential (Purkey & Siegel, 2013). Haigh (2011) agrees that iinvitational learning is based on the Invitational Learning Theory that argues that learning is made meaningful when learners are invited and accepted into the learning environment using improved strategies. Invitational Education (IE) is a theory of practice that aims to create and maintain a humane school environment that intentionally and cordially invites individuals to realise their unlimited potentials in all areas of worthwhile human endeavour (Purkey & Novak, 2015).

This theory identifies and defines five major domains namely, people, places, policies, programmes and processes, known as the powerful five 'P's'. These five domains are essential in understanding and implementing the invitational theory (Purkey & Novak, 1984). Invitational theorists agree that people are able, valuable and responsible and should be treated accordingly. Educating should be a collaborative, cooperative activity between the relevant stakeholders. The process is the product in the making; people possess untapped potential in all areas of worthwhile human endeavour and this potential can be realised by places, policies, programmes and processes specifically designed to invite development and by people who are intentionally inviting themselves and others, personally and professionally (Purkey & Novak, 2015; Purkey & Novak, 1984; Purkey & Schmidt, 1990).

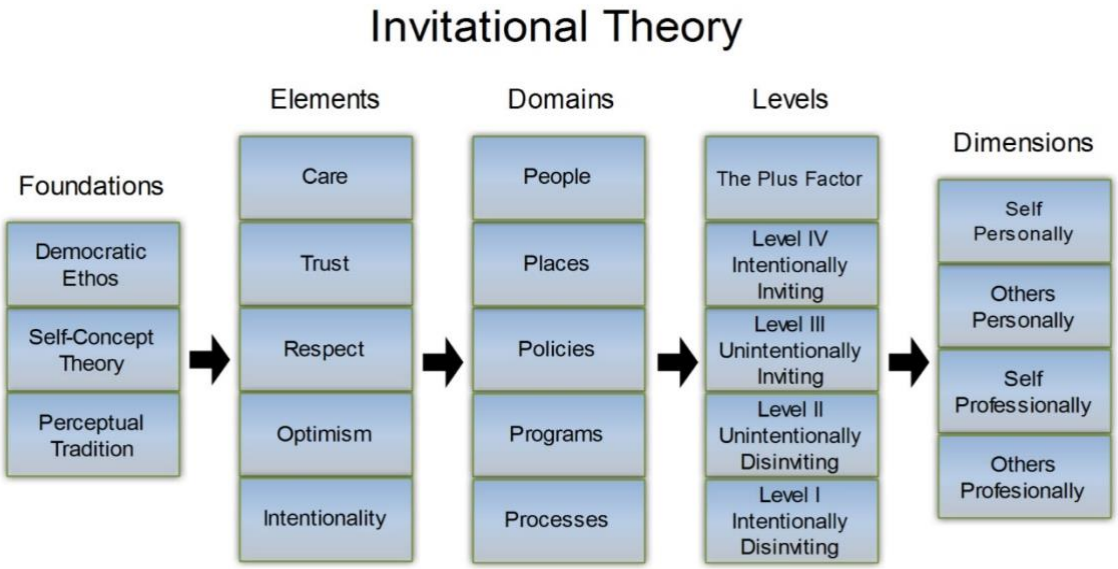

Figure 1.

Invitational Theory Source: (Purkey & Novak, 2015)

Aim and Problem of Study

The main purpose of the study was to explore how school leaders and teachers organise their learning spaces as well as their methods of teaching and learning to improve the quality of education. This study looked at Foundation Phase schools that were culturally diverse within the South Africa context. These schools accommodated learners from different cultural backgrounds and ethnicity. The study is underpinned by Purkey and Novak's Invitational Learning Theory which argues that invitational practices have a significant impact on the quality of learning and teaching (Purkey & Novak, 1996).

Method

Research Model

The researchers agreed that a qualitative research method of a descriptive nature was most suitable to be used in this study since it provides an in-depth study of the phenomenon using an interpretivist research paradigm (Maree, 2017). The descriptive design allowed the researchers to gain a detailed account of the experiences from the participants regarding the creation and leading of an invitational learning environment in their schools. A case study approach was used as an intensive study about a person, a group of people or a suit, aimed to generalise over several units (Gustafsson, 2017).

Participants

A sample of three (3) Foundation Phase teachers and four (4) school management teams comprising of two (2) principals and two (2) heads of department members were invited to participate in this study. The sample consisted of teachers from Grades 1, 2, and 3 and the school management teams from two schools in the Tshwane District of the Gauteng Province in South Africa. The criteria in selecting the participants were very specific; teachers had to be actively involved in attempting to create an environment that is inviting and conducive to teaching and learning; school leaders were supportive and flexible to teachers using different approaches to ensure a positive climate in their schools. School management teams also had to allow teachers to be creative and innovative in the approach to creating an invitational learning environment. The participants were selected using purposive sampling since this study required participants who would accurately represent the population in question (Battaglia, 2011).

Table 2.

Structures of Participants

Participant No	Gender	Age	Code
P1 or School Leader1 (SL1); S-A (School A)	F	56	P1-F--SL1-SA
P 2 or School Leader (SL2); S-B (School B)	M	58	P2-M-SL2-SB
P3 or Head of Department (H1); S-A (School A)	F	48	P3-F-H1-SA
P4 or Head of Department (H2); S-B (School B)	F	58	P4-F-H1-SB
P5 or Teacher (T1); S-A (School A); Grade 1 (G1)	F	34	P5-F-T1-SA-G1
P6 or Teacher (T2); Grade 2 (G2)	F	32	P6-F-T2-SA-G2
P7 or Teachers (T3); Grade 3 (G3)	F	26	P7-F-T3-SB-G3

Data Collection Tools

Data were collected from semi-structured interviews and classroom observations.

Semi-structured Interview From

The semi-structured interview form was developed by the researcher (one of the authors) together with the research supervisor. The semi-structured interview form collected biographical data and questions pertaining to the 5Ps (Appendix 1 – School Management Team; Appendix 2 – Teacher). There were a total of 27 questions for SMTs and 29 for teachers.

Observation From

The observation schedule was adapted from Purkey and Novak's Inviting school survey document. Both the researcher and the supervisor finally agreed upon the observation schedule (Appendix 3). There were 11 areas that the researcher observed.

Data Analysis

Using Creswell's steps in data analysis, the data were transcribed and analysed by organizing and sectioning responses into units, synthesising them, identifying patterns as well as ascertaining which data was of importance and needed to be shared (Creswell, 2012).

Ethics

Permission for the study was granted by the ethics committee of the University of Pretoria and the Gauteng Department of Education. All participants were formally invited and they gave written informed consent. They were also made aware that their participation was voluntary and that they were not obligated to remain throughout the study. All seven participants consented to participate in the face-to-face interview and classroom observation. They were also guaranteed their anonymity and that during the reporting phase pseudonyms would be used. The following codes were used to protect the identity of the participants. For school leaders P1-F-SL1-SA (P1 – participant 1; F – female; SL1 – school leader 1; SA – School A); Heads of Department (P3- participant 2; F-female; H1 – Head of Department 1; SA – School A or B will indicate school B); and for Teachers (P5-7 – participant number 5; 6 or 7; F – female; T1-3 – teacher number 1, 2 or 3; SA-B – School A or B; G1; 2 or 3 – Grade 1; 2 or 3).

Procedure

The researcher conducted one interview and observation with the participants during the period 5-30 March 2019. The sites were school A and B in the Gauteng Province. The table below indicate the dates, times and venue for both interviews and observations.

Table 2.
Data Collection Process

Participant	Interview Date	Observation Date	Time	Venue
P1-F-SL1-SA	05.03.2019		14:00	School A
P2-M-SL2-SB	08.03.2019		14:00	School B
P3-F-H1-SA	12.03.2019		14:00	School A
P4-F-H2-SB	15.03.2019		14:00	School B
P5-F-T1-SA	20.03.2019	20.03.2019	09:00-10:00	School A
P6-F-T2-SA	22.03.2019	22.03.2019	09:00-10:00	School A
P7-F-T3-SB	30.03.2019	30.03.2019	09:00-10:00	School B

Results

The study explored how school leaders create and lead a learning environment in diverse Foundation Phase classrooms in a South African school. In this section, the themes that emerged from the data analysis are presented. The data consisted of interview questions and the participants responded to each of these questions.

Understanding of Invitational Teaching and Learning

Since the concept of invitational teaching and learning is vaguely used in the South African school context it was important to the researchers to elicit the participant's understanding of this concept. During the face-to-face interview, participants were asked what was their understanding of 'invitational teaching and learning. The response varied from both school leaders and teachers.

Both the school leaders agreed that invitational teaching and learning is about making sure that the school environment is positive and that everyone on their staff were happy. They both agreed that as school leaders it was their responsibility to invite everyone into their schools. It was not only about the teachers, it included the learners and the general workers who helped to make sure that the school is 'inviting'. Probing further, the researcher asked the school leaders about the school climate and to this probe, both school leaders indicated that their understanding of the school climate is the atmosphere that they create in ensuring that the learning space is safe, welcoming, receptive and appealing to everyone who enters this space. They both agreed that the 'invitational learning' and 'school climate' were terms that were about creating schools that can accommodate diversity and cultural acceptance. P1-F-SL1-SA also highlighted that his school was made up of 96% of learners who came from an African background and therefore as school leaders they are required to create and lead a learning environment that accommodates cultural diversity. Both these school leaders concurred that there was no place for a 'racial divide' in their schools. They had embraced and accepted all persons who enter the school as equals and as a rightful citizen in this country.

In response to the same question to heads of departments, P3-F-H1-SA indicated that 'invitational learning' was a new concept to her. She had not heard of this concept; however, she assumed that it was about inviting teachers and learners wholeheartedly into the learning environment. She went on to state that in the Foundation Phase, everyone has to show love, warmth and respect for each other, including the learners. P4-F-H2-SB in her response indicated that her understanding of 'invitational learning' was making learning easy and accessible to all learners. She indicated that the policy on inclusive education speaks about accommodating all learners and therefore 'invitational teaching and learning' was about making sure that all learners can understand what was being taught and that they must be able to learn something new each day. She further indicated that 'invitational teaching and learning' was about creating a school that is a pleasure to attend; however, she reiterated that 'that would be the ideal situation'. In the same vein, she indicated that we cannot say the same for our schools with the limited resources and large numbers.

According to all three teachers, their understanding of 'invitational teaching and learning is making sure that their classroom space was child-friendly and accommodating. The teachers agreed that they must invite their children into their classrooms for successful invitational teaching and learning. The young learners must not be afraid, they must see school as a pleasure and fun place to be. All the foundation phase teachers indicated for them invitational teaching and learning were more about making sure that every learner had the opportunity to learn and that every learner was respected in the classroom. They also stated that their classrooms were very diverse and therefore they must invite everyone as 'equals' and that each child 'has the right to be in the class'.

The photographs below illustrates the classroom environment in both the schools.

Photo 1.
Classroom Environment at Schools

The artwork displayed in these classrooms were mutually agreed upon with learners to be displayed. All three teachers indicated that their school leaders gave them the opportunity to create a friendly learning environment. The researcher observed the both learners and teachers, were mutually responsible to create an invitational learning environment. The time-out chair was used as a mean of disciplining learners rather than using corporal punishment – which is against the law in South Africa.

Support to Create and Lead a Learning Environment in a Diverse Foundation Phase classroom

The term support may refer to a variety of instructional methods, educational services or resources provided to improve the quality of teaching and learning. This term may also refer to several academic-support strategies that can be implemented in an educational environment. It is an act of showing that you believe, respect, acknowledge and appreciate the work or activity done by a staff member or learner. Support is also defined as providing comfort and encouragement within a learning environment.

According to the Department of Basic Education's (DBE) policy on Standards for School Principals, this policy clearly articulates the crucial role principals (school leaders) play in ensuring that their school environment is conducive to teaching and learning [30]. When the participants (school leaders) were asked how did they support their teachers to create a positive learning environment in their schools, the responses from both the school leaders and heads of department are presented below. The quotes are verbatim. P2-M-SL2-SB indicated,

> *as a leader in my school, it is my responsibility to ensure that my teachers and learners are safe in the school environment. We are living in a neighborhood that has a high crime rate. I have made sure that my school is well-fenced and we have a security guard at the gates. No person is allowed on the property without providing their personal details and reasons for wanting to enter the property. In this way, I make sure that my teachers and learners are working in a safe and conducive environment without fear and threat". In his response to school safety, P2-M-SL2-SB stated, "my school is built within the community and we have security guards and electric fences around the perimeter of the school. We have strict rules of entry into the school. Learners and visitors enter the school through the pedestrian gates that are controlled and monitored by a private security company. My school has a school-friendly policy; an anti-bullying policy and a safe-school policy. These policies help to ensure that the school environment is safe and secure for teaching and learning.*

When the research probed into their management style and how they created and led a learning environment in their schools, both P1-F-SL1-SA and P2-M-SL2-SB indicated that they had adopted a democratic leadership style that encouraged participation by all staff and learners. They both believed in ensuring that all their staff members are given equal respect and opportunities to be active participants in contributing to the positive climate of their schools. They believed that for a healthy school environment, teacher's voices must be heard and appreciated. Every teacher has an input into the educational success of the school and therefore both P1-F-SL1-SA and P2-M-SL2-SB indicated that by empowering teachers to share their inputs they are becoming part of the leadership action plans of the school. Both school leaders agreed that creating a positive environment in their schools was about giving teachers freedom and flexibility to try out new methods and approaches to enhance teaching and learning. P1-F-SL1-SA stated,

> *these young teachers coming from universities are always teaching us new methods they have learnt at their institutions. For example, play-based learning is being successfully implemented in the Foundation Phase classroom. I am really proud of these young teachers with their new methods. I, therefore, give them an opportunity to do demonstration lessons for the older teachers in the schools". In his school, P2-M-SL2-SB shared his experience with the researchers by stating, "We have three young teachers from different South African universities. They have come to my school and introduced technology for teaching and learning in the Foundation Phase. On their own initiative, they got iPads sponsored for their learners in the Foundation Phase. I have now allowed teachers to use technology for teaching and learning. It is really*

interesting to see how children are working with technology. I am hoping to set up a computer laboratory for the intermediate and senior phase classes in the school.

Both school leaders agreed that their leadership style is inclusive, flexible and adaptable. They do not see themselves as 'policy pushers' but as adapting the policies and guidelines to improve and invite classroom success. They concurred that the education system is changing and that they need to be flexible and pragmatic in the way they lead their schools. School leaders also shared their views that in the past decade, school leaders were mere "headmasters', but today they see themselves as instructional leaders and promoters of innovative and creative teaching strategies. They have indicated that they were willing to change their views of how schools should be managed thus keeping up with 21st-century education.

Both heads of the department agreed that they were very supportive of their foundation phase teachers. They both believed that their leadership style was envisioned by 'lead by example' and the use of a mix of directives and asking for opinions. They supported their teachers by allowing them to be flexible in adapting the curriculum to the needs of learners. Although the DBE has developed several policies to promote quality teaching and learning, teachers are using the Policy on Inclusive Education: White Paper 6 as a guideline to adapted and accommodate all learners in their diverse classrooms. P3-F-H1-SA shared her excitement by indicating to the researcher,

my Foundation Phase teachers decided to decolonise the curriculum by introducing cultural mathematics and games in their lessons. I can see the joy and excitement in the diverse foundation phase classroom. Learners are playing cultural games in mathematics for example 'Upuca' – a traditional game among Xhosas as well as Africans in the South African countries with different names per culture. This game develops mathematical concepts, skip counting, one-to-one correspondence, eye and hand coordination and hand motor skills. Another game is 'Black toti' – a children's game played in rural South Africa. Through this game, children learn sorting, counting and balancing, logic, time management and concentration skills. This game also demands planning, motor skills, self-regulation, teamwork and time management.

P3-F-H1-SA also highlighted the excitement among the learners during play in their diverse classrooms. She stated that learners were beaming with pride because they can identify with the teaching and learning activity.

Both heads of department agreed that to create a leading learning environment, there must be flexibility, adaptability, acknowledgement, recognition, praise and reward to ensure that learning within a diverse environment is successful. They too agreed that although the DBE policies were there as a mandate for implementation, they also allowed for a degree of flexibility for implementation. This was well articulated in the inclusive education policy. With a diverse cohort of learners in the foundation phase whose home language is not the Language of Learning and Teaching (LoLT) in the school, school leaders, heads of departments and teachers must be willing and flexible in how they approach teaching and learning in their classroom.

According to the three teachers (P5-F-T1-SA ; P6-F-T2-SA ; P7-F-T3-SB) , they all agreed that their school leaders and heads of department have been very supportive in their interventions of creating an invitational teaching and learning environment within their diverse foundation phase classroom. P5-F-T1-SA said,

my head of department allowed me the freedom to try as many methods as possible to improve teaching and learning. Most of my learners cannot speak English and I had to code-switch in my class. Although the policy indicates that we should teach in the medium of instruction, I am allowed to code-switch. I am also given the opportunity of inviting a parent in my class to assist me with the language barrier and or translation of mother-tongue language' (P5-F-T1-SA).

P6-F-T2-SA and P7-F-T3-SB stated that their heads of department allowed them to display posters with different languages and cultures in their classes. Learners in the foundation phase are exposed to various posters that depict different religious and cultural practices. All these teachers also indicated that they have introduced African literacy and ethnomathematics into their curriculum with the support of their school leaders and heads of departments. They found that their learners can identify with games, stories and practices from their cultural background, thus, making learning contextual, fun and exciting.

According to school leaders, heads of departments and teachers they believed that they have organised their learning spaces to accommodate diversity, inclusivity, adaptability, flexibility and innate pride and joy within their learning environments. They agreed that it was through supportive leadership that they were able to create and lead a learning environment that accommodated the principles of inclusivity as articulated in the DBE's policy on inclusive education.

Discussion

To create and lead a learning environment in a diverse classroom in South African schools, this study used the five domains of Invitational Theory that exist in almost every learning environment. School leaders are in an ideal position to implement five powerful 'Ps" – people, places, policies, programmes, processes (Purkey & Novak, 1984).

People (especially school leaders and heads of departments) can influence the learning environment positively or negatively. School leaders are role models in their environment (Hunter & Smith, 2007) and they set the standards for behaviours, attitudes and actions. If school leaders are trusting, encouraging, motivating and believing in the teaching staff, the attitudes of teachers towards positive teaching and learning are encouraged (Cross & Hong, 2012). It is important to note that teacher's beliefs in themselves and their learners are crucial factors in determining the effectiveness of teaching and learning in the classroom (Purkey & Novak, 1984). Similarly, school leader's belief in themselves and their teachers will ensure a positive outcome and success to invitational teaching and learning. It is agreed that if an individual is more accepting of themselves, they tend to be more accepting of others and therefore see others as more accepting and approachable (Purkey & Novak, 1984). In this study, the researcher concurs with Purkey, that most school leaders and heads of department showed trust and acceptance of their foundation phase teachers and believed in their potential to improve the quality of teaching and learning in their diverse classrooms. The researchers believe that believing and demonstrating a positive, accepting and open-minded attitude through school leaders' actions and interactions with and with others, will eventually influence everyone in the environment to act and behave positively towards invitational teaching and learning.

The creation and leading of an invitational learning environment are significantly influenced by the physical environment in which teachers and learners meet and work together (Purkey, 1999). It is important to nurture a sense of emotional and psychological safety in the learning environment to facilitate effective teaching and learning opportunities (Department of Basic Education [DBE], 2015). A safe and productive learning environment requires the creation of participatory and collaborative learning opportunities so that teachers can feel connected and appreciated (Purkey & Novak, 1984). Findings in this study indicated that school leaders ensured that their schools were safe environments for invitational teaching and learning. Schools leaders ensured that they developed safety policies for both teachers and learners. Schools leaders ensured that their schools were well guarded and protected against school violence or criminal activities by employing security services. Teachers were delighted to be working in a safe environment, thus concentrating on ensuring an environment conducive to teaching and learning (Haidari & Karakus, 2019). Both school leaders and teachers identified the 'place' domain of an invitational learning environment as extremely important. From the study, it was found that teachers created an environment that embraced various cultural backgrounds, languages and practices within their diverse classrooms. They included cultural games, ethnomathematics, African literature and other resources in their teaching programme. Through school leader's support and encouragement, teachers created a safe and conducive environment that acknowledged and recognised all learners within a diverse classroom. Hunter and Smith (2007) concur with the teachers in this study that having a bright and warm environment invites those who enter it to share their experiences. This was evident when heads of departments in both schools allowed teachers to introduce a variety of learning strategies (for example, indigenous games; African stories) and posters displaying different cultural practices in their classrooms.

Purkey and Novak (1996) think that no environment is possible without policies to reinforce and monitor different ideas. Policies employed in all South African schools are developed by the Department of Basic Education. However, in this study, the schools abided by the written policies and also school leaders allowed the implementation of invitational teaching and learning through unwritten policies. They argued that the department of education's policy allows school principals and teachers the flexibility of adapting the curriculum to the needs of the learners (DBE, 2001). Most school leaders in this study believed that school-wide and diverse classroom rules should not be imposed arbitrarily but should evolve from commonly held values and principles of the school community. At a classroom level, teachers indicated that they prepared 'classroom ground rules' to ensure and maintain discipline and order in their diverse classroom to promote invitational teaching and learning through mutual respect, tolerance and trust. These ground rules were developed together with the learners in their classes. According to Chandra (2015), classroom management aims at establishing learner self-control through a process of promoting learner behaviour and achievement.

All participants agreed that through democratic and inclusive leadership in their schools, they were able to manage to create an invitational teaching and learning environment. There was a high degree of commitment from school leaders and teachers together to sustain a positive learning environment through respect, implementation and

acceptance of written and unwritten policies in their schools. The success of creating a positive learning environment is the responsibility of every staff member (Mejia, 2016).

Invitational programmes are described as enriching, stimulating, engaging, developmental, interactive and constructive. This study found that school leaders allowed for teaching and learning programmes to be enriching and stimulating to learners (Purkey & Novak, 2015). Teachers were given the opportunity of adapting the National Curriculum Statement: Curriculum and Assessment Policy Statement to include content that is relevant to the life-world of the learners (DBE, 2001). Purkey and Novak (2015), agree that relevance is a key factor in intrinsically motivating teachers to accommodate the learner's real-life situation in their teaching and learning. Hunter and Smith (2007) state that when programmes are introduced in schools, these programmes must ensure that no learner is discriminated against or experience bias or prejudice. Teachers must also avoid stereotyping when implementing invitational teaching and learning in a diverse foundation phase classroom. Since school leaders and heads of department were flexible in their approach to teaching and learning, teachers were afforded the opportunities of trying out various strategies in their classroom, including cooperative teaching and learning. Teachers were benefitting from visiting and observing each other's lessons. It must be acknowledged that cooperative learning, an aspect of invitational education creates opportunities for group and individual accountability (Purkey & Stanley, 1991).

The processes by which an individual monitor and maintain the other four 'Ps" functioning is crucial (Purkey & Novak, 1984). Through the maintenance of a positive attitude, cooperation, caring and respectful environment, with programmes and policies to suit the needs of teachers and learners, school leaders are in a better position to encourage, positivity among their staff to invite school success (Purkey & Novak, 1996). Through collaborative working, educational change and effectiveness depend on people who show respect, trust and willingness to work together in an enabling environment (Yin, 2008). Collaboration and cooperation are interdependent with invitational education (Purkey & Novak, 2015).

Conclusion

A people-centric environment focuses on people within the environment, thus making them the number one priority. In their work, Purkey and Novak (2015) emphasise the importance of people in an organisation and their contribution to success or failure. It is of utmost importance that people are treated with respect, care and tolerance. Each individual comes into a learning environment with different ideologies and philosophies; therefore, school leaders must embrace these ideologies and philosophies for the beneath of the organisation (school environment). The first step in creating an invitational learning environment is to build a relationship with the staff. The relationship should be based on mutual trust, knowledge and understanding. When school leaders acknowledge the individuality of each staff member and invite them into a positive, safe, welcoming and conducive environment – there is guaranteed success for the creation of an effective learning environment.

In the book *Inviting Classroom Success,* Purkey and Novak (1984) state that to create an invitational learning environment that is not toxic, school leaders and teachers must work collaboratively and cooperatively. This study found that school leaders

- Adopted a very inclusive management approach to creating and leading a learning environment in a diverse classroom in a South African school.
- They showed flexibility in their leadership style, believing in the potential of newly qualified teachers, embracing new teaching methodologies and strategies to accommodate learners in a diverse classroom.
- Human potential can best be realised by places, policies, programmes and processes specifically designed to invite development and by people who are personally and professionally inviting with themselves and others.
- School leadership is an enormous responsibility and requires a visionary leader to shape the academic success for all learners and teachers in their school.
- They responsible to create a climate hospitable to education
- School leaders need to manage people, data and processes to foster school improvement (Wallace Foundation, 2013) and
- be focused on instruction and forge partnerships with communities and stakeholders.

The major challenges faced by school leaders in most South African schools are overwhelmed teachers, irate parents, school violence, teacher absenteeism and passive bullying. Against all odds, school leaders are working tirelessly together with their staff and communities to ensure the promotion of quality teaching and learning.

Recommendations

The authors recommend that the Powerful 5Ps is a good strategy for all school leaders and teachers to implement in their classes. In any situation the Powerful 5Ps, if implemented democratically will create and invitational learning environment. It is also recommended that every staff member in an organisation should be professionally inviting with oneself – this would provide the individual with an opportunity for self-growth and professional development to create an invitational learning environment. It is also recommended that all school leaders, heads of departments and teachers need to be professionally inviting with others. At management level, school leaders and heads of department should create an open-door policy in their schools and to accept less-than-perfect behaviour of human beings. This applies also in a diverse classroom where teachers begin to understand and accept all learners and their diverse background.

Recommendation for Further Research

Since this study was limited to one district in a well-resourced province in the country; it is recommended that further studies of a similar nature be conducted in the rural provinces of the country. The authors envisage findings that may not be congruent to the more affluent provinces due to the lack of resources and appropriately qualified and appointed school leaders; heads of department and teachers which impact on school management and the promotion of invitational teaching and learning.

Limitations of Study

The research was limited to addressing the phenomena in two schools in one district in the Gauteng Province in South Africa. Provincial dynamics differ vastly from other provinces. For this reason, this study should be conducted in deep rural schools in the different provinces.

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Appendix 1.

Semi-structured Interview Form-School Leadership and Management

Semi-Structured Interview Schedule: School Management Team

Instructions:

1. Kindly respond to all questions.
2. The interview schedule consists of 7 sections.
3. Mark with an "X" where relevant

Section 1

Biographical Data

1.1 Age

1.2 Gender

Female	
Male	

1.3 Post School leader

Head of Department

Section 2

General

2.1 What is your understanding of an invitational learning environment?

Section 3

People

3.1 How do you promote relationship characterized by trust and respect between learners?

3.2 How do you make educators feel invited in work place?

3.3 How do you promote an atmosphere of care among staff members?

3.4 Do you feel that staff members can approach you with problems?

- How do you ensure this?

3.5 What is your role when encouraging teachers to create inviting learning environments?

Section 4

Places

4.1 How much importance do you place on creating an aesthetic and inviting/conducive classroom?

4.2 How would you describe a physical environment that is inviting?

4.3 How would you describe the physical attributes of your school?

4.4 What could you improve at your school in terms of the ascetics?

4.5 If these the above- mentioned things were improved, what impact do you think it would have on the teachers and the learners?

4.6 Would you like to share any other information about the school environment?

Section 5

Policies

5.1 How do your school policies create inclusion?

5.2 How do you approach discipline amongst learners?

5.3 How do you ensure consistency in treatment of learners?

5.4 How do you promote tolerance and equality in the school?

5.5 How do the school policies protect learners and teachers?

5.6 Would you like to share any other information about the policies in your school?

Section 6

Programmes

6.1 How are your school programmes enriching and stimulating?
6.2 What steps do you take to ensure programmes are engaging and constructive?
6.3 How would you change current programmes in your classroom to be more enriching and constructive?
6.4 Do you have programmes that are aimed at teacher development needs?

Section 7

Processes
7.1 How do you maintain a democratic ethos in the classroom?
7.2 What do you do to ensure educators feel encouraged?
7.3 How do you ensure collaboration amongst teachers?
7.4 How do you encourage cooperation between teachers?
7.5 How does you support teachers needs in creating an invitational learning environment?

Appendix 2.

Semi-Structured Interview Schedule : Educator

Instructions:

4. Kindly respond to all questions.
5. The interview schedule consists of 7 sections.
6. Mark with an "x" where relevant

Section 1

Biographical Data

1.3 Age

1.4 Gender

Female	
Male	

1.5 What grade do you teach?

Section 2

General

2.1 What is your understanding of an invitational learning environment?

Section 3

People

6.1 How do you promote relationship characterized by trust and respect between learners?

6.2 How do you show learners that you care for them?

6.3 How do you promote an atmosphere of care in the classroom?

6.4 Does your relationship with colleagues effect your attitude towards your job?

3.5 How does the school management team make the work environment conducive to teaching and learning?

3.6 Would you like to share any other information regarding the people in your school?

Section 4

Places

4.1 How much importance do you place on creating an aesthetic and inviting/conducive classroom?

4.2 How do you create spaces that are personal and warm as well as functional and efficient?

4.3 How do you feel about the way your school grounds, bathrooms and other physical attributes look?

4.4 What could you improve at your school in terms of the ascetics?

4.5 If these the above- mentioned things were improved, what impact do you think it would have on the teachers and the learners?

4.6 Would you like to share any other information about the school environment?

Section 5

Policies

5.1 What classroom policies do you have in place that create inclusion in the classroom?

5.2 How do you approach discipline amongst learners?

5.3 How do you ensure consistency in treatment of learners?

5.4 How do you promote tolerance and equality in the classroom?

5.5 To what extent do you feel the CAPS policy document is consistent and promotes equality?

5.6 How do the school policies protect learners and teachers?

5.7 Would You Like To Share Any Other Information About The Policies In Your School?

Section 6

Programmes

6.1 To what extend to you feel the content of what you are teaching is enriching and stimulating?

6.2 What steps do you take to ensure lessons are engaging and constructive?

6.3 How would you change current programmes in your classroom to be more enriching and constructive?
6.4 How does your use of the CAPS policies make provision for enriching, stimulating and culturally responsive teaching and learning?

Section 7
Processes
7.1 How do you maintain a democratic ethos in the classroom?
7.2 What do you do to ensure learners feel encouraged in the classroom?
7.3 How do you ensure collaboration amongst learners?
7.4 How do you teach cooperation between learners?
7.5 How does the SMT support your needs in creating an invitational learning environment?

Appendix 3

Observation Form

Educator observation sheet– *Adapted from The Inviting school Survey*

How does the teacher show learners care?

- Learners are recognized as individuals , this is seen in the personalized birthday charts , each child's photo is displayed on their month.
- Another part of the classroom has a pin board where learners can share photos of their families.

How does the teacher promote elements of trust and respect?

- The teacher shows learners respect by taking time to help each child.
- Each child has a job, shows the teacher trusts the learners.

How is the classroom visually inviting?

- Lots of bright visual media is placed on the walls.
- Fun educational posters.
- Pretty, age appropriate decorations.

How does the teacher ensure learners are treated equally and consistently?

- Discipline is consistent, learners who break the rules are given the same punishment.
- All rules apply equally to all learners.

How is the space made warm and personal as well functional and efficient?

- Each desk has a little dustbin which minimizes unnecessary movement, also helps the learner feel ownership and care.
- Classroom is kept clean and neat.
- Designated areas for learning.

Describe the classroom policies that ensure inclusion?

- Class rules ensure inclusion such as " Take turns with others" and " Treat others with respect".

Describe the discipline in the classroom?

- Very strict sense of discipline in the classroom , which made it hard to read the environment at times , not much movement or conversation , may convey a sense of distrust to learners.
- Teacher keeps problematic learners engaged by getting them to read and answer questions.

How is content presented in an enriching and stimulating manner?

- Teacher uses teaching media to make the lesson stimulating

Describe how lessons are engaging and constructive?

- Teacher varies her tone of voice to keep learners engaged
- Teacher herself is engaged in her lesson makes learners interested

How are learners made to feel encouraged?

- Learners are encouraged to participate through questioning techniques , by asking questions learners are encouraged to be involved.

How is collaboration amongst learners encouraged?

- The majority of lessons are taught in a group setting on the carpet. Learners are encouraged to give their opinions on what others have answered.

Other notes:

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Research Article

Implementing the updated early childhood development curriculum in Zimbabwean primary schools: social validity based on practitioners' views

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Abstract

This article analysed the level of social validity on implementing the updated Early Childhood Development (ECD) curriculum in Epworth, Mabvuku, Tafara (EPMAFARA) District in Harare, Zimbabwe. To address the ever-changing world economy, Zimbabwe introduced an updated curriculum in all its primary schools, in 2017. The updated curriculum provides a framework for the knowledge that help young people to develop a sense of independence and self-reliance. A qualitative method was employed to explore curriculum implementation in Zimbabwean primary schools. Data were collected from a purposively selected sample of two District Schools Inspectors, four School Heads/ Teachers in Charge and eight ECD teachers. The data were analysed using the NVivo software. The researchers discovered that as well as exposing some gaps in the implementation practice, the study revealed some advantages namely, competence-based component, child centred methods, skills-based approaches, change and nurturing of various children's talents among others. The disadvantages encountered comprised lack of financial and human resources and school basic infrastructures, excessive workload for teachers, lack of Information, Communication and Technology skills and high- teacher: pupil ratio. The qualitative research method used was one major limitation since it was time consuming and, labour intensive. The researchers' initial sample was further affected by COVID-19's onset in the country in March 2020, when the World Health Organization (WHO) advised lockdown restrictions, causing schools to close abruptly. The paper's findings underscored the significance of planning for change in ECD educational programs in terms of teachers' preparedness and stakeholders' resourcefulness. These findings imply that teachers should be trained to become innovative and creative in curriculum implementation. Stakeholders are recommended to support teachers and schools with prerequisite resources.

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Introduction

One of the seminal changes that occurred with the advent of a democratic government was the change in the education system. Access to high-quality, relevant education for all Zimbabweans is seen as a fundamental right and the bedrock of the country's cultural, social, economic, and democratic development (Zimbabwe Constitution, 2013:46; Zimbabwe Curriculum Framework, 2015:4). Early years practices are very influential in a child's holistic development matrix hence the importance of Early Childhood Development (ECD) education. ECD is an important component of basic education and the first step in achieving the Education for All (EFA) goals established at the 1990 World Conference on EFA in Jomtien, Thailand, the 2000 World Education Forum in Dakar, Senegal, and the United Nations

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Millennium Development Goals (MDGs) (Myers, 2004:3; Soud, 2009:23). This led to rethinking on ECD and its mandatory inclusion in primary schools. The ECD updated curriculum in the country was the brainchild of Dr Lazarus Dokora, the former Minister of Primary and Secondary Education. The blueprint was an attempt to buttress the Nziramasanga Commission (CIET, 1999), recommendations to avail pre-primary education to all Zimbabwean citizens irrespective of their social status.

Zimbabwe attained its independence on 18th April 1980 and the government in 1982 started redressing the discrepancies in early childhood education (ECE) which was predominantly for white children. The previous curriculum was also chastised for being overly intellectual and preventing students from pursuing mechanical interests at an early age. The need for things to change resulted in the proliferation of ECE centres, especially in rural locations, housed under trees and staffed by inexperienced workers. Early Childhood Education and Care (ECEC) was housed in the ministry of Community Development and Women's Affairs which had 'little to do with education' (Ministry of Community Development and Women's Affairs, 1996). In 1988, ECE was transferred to the Zimbabwe Ministry of Education. The transfer of ECE to that ministry did not make much headway, with the majority of the children in the rural areas still not benefitting from the initiative. The thrust was on preparing children for school readiness but there was not much progress noted, hence there was need to restructure the programme for it to produce the desired goals. The Ministry of Education only offered a policy framework to oversee ECE centres run by local governments, communities, church groups, private organizations, and individuals during this time (UNESCO, 2006). With the passage of time, education officials and other interested parties noticed that much of the curricula in private pre-schools was obsolete and insufficient for children of school age, and that family circumstances were not conducive to learning (UNESCO 2006). It became incumbent for collaboration and coordination across all levels and ministries to ensure a strong and cohesive ECE policy (UNICEF, 2009).

Grade Zero / ECE was mandated to be adopted in all primary schools with effect from 2006, after choices reached in 2005 to guarantee that every child had a fair start (Zimbabwe Ministry of Education, 2006). As a result, it was absorbed into the general education development policy framework and formed part of Zimbabwe's overall development reality, which is now coherent, methodical, complete, and proactive. The Ministry of Education, Sport and Culture released Secretary's Circular 14 of 2004 for primary schools to attach two ECD classes (A and B) with effect from 2005. According to the Director's Circular Number 12 of 2005, the class of 3-4-year olds was called ECD A and the class of 4-5-year olds was ECD B (Mushoriwa & Muzembe, 2011).

Hitherto, the bulk of Zimbabwean children, particularly those in rural areas and other low-income communities, did not have access to the recently implemented Grade Zero/ECE program. To address this anomaly, a new two-tier curriculum starting at ECD A to ECD B was introduced in primary schools in 2017, and no child would be accepted into grade one without attending ECD for the two years. The current ECD updated curriculum is the blueprint covering the period 2015-2022 premised on government policy. The Daily News (2018:1) reported that the launch of the Zimbabwe new Curriculum Framework in Kadoma, a town in Mashonaland West Province of Zimbabwe, in June 2018, sparked heated debate with parents and teachers accusing the government of railroading the programme into the educational system without adequate consultations (Muzembe, 2021). Despite the criticism, the updated ECD curriculum is competence based and it promotes collaboration among learners.

Figure 1.

Understanding the Updated/Competence Based Curriculum Source: Zimbabwe Ministry of Primary and Secondary Education (2015-2022) http://mopse.co.zw/mopse/about-ministry

Teachers are frontline service providers in education and have the responsibility for preparing the children for a better future. This means that teachers must keep abreast with changes in 'education' especially in today's digital world where 'internet' has created a global village. Hence, computer skills for ECD teachers become critical in the instruction of Science, Technology, Engineering, Art, and Mathematics (STEAM) in their practices. It also implies that the Ministry of Education must harness ICT as enabling learning tools in schools to ensure continuous learning for children now under the looming shadow of COVID-19.

The Research Significance

The social significance of ECD curriculum implementation is to evaluate the social validity that elucidates the child behaviour change in achieving educational goals. There is still inadequate information on how practitioners in economic crises and looming COVID-19 pandemic implement the ECD updated curriculum considering social and economic variations in the country. Despite previous research on curriculum implementation conducted across the globe, in Zimbabwe there is minimal focus on how teachers and stakeholders prepare to improve the process. It is against this backdrop that a research becomes significant to be carried out. The study highlighted the advantages and limitations of the updated ECD curriculum. This study informs the policy makers, stakeholders, and other citizens on the best way to prepare and support teachers in the curriculum implementation process. In the main, it is envisaged that this research enriches the secondary sources of education information for colleges and universities as it forms a firm foundation where future research can be laid upon.

The Research Terms

Curriculum Implementation

The translation of an anticipated or formally created course of study into syllabuses, plans of work, and lessons to be delivered to students is referred to as curriculum implementation (Bediako, 2019). It is also the actual interaction of the learner with expected learning opportunities. This includes the instructional materials that will be used in the classroom.

Early Childhood Development

The term "early childhood development" refers to the time between conception and the start of school. It is a window of opportunity for a child's cognitive, social, emotional, and physical development that occurs because of the child's contact with his or her surroundings (UNICEF 2018:2).

ECD A and ECD B

In Zimbabwe, ECD A refers to children aged 3 to 4 years, while ECD B refers to children aged 4-5 years. As a result of the Nziramasanga Commission (1999) recommendation, this was effected as a regulation.

Innovation

According to Bessant (2009:6), the word 'innovation' comes from the Latin words in and novare, meaning "to make something new, to change." Innovation is therefore the application of ideas to create new ways of doing things.

Practitioners' views

The practitioners' views about curriculum implementation refer to the District Schools Inspectors', school Heads'/ TICs' and Teachers' mindset in the manner they think and feel towards what they are supposed to do. A view is not shaped in a vacuum, it determines our approach to life and relationships with others.

Social validity

The suggested intervention and the planned replacement behaviour's social validity refers to whether they are socially acceptable behaviours (Kazdin, 1977).

Literature Review

The analysis of related literature directs the research, demonstrates the evolution of knowledge, and combines and summarises what is known as the subject area. The ever-growing world economy has brought new challenges and new requirements in the education division (Mulena & Kabombwe 2019). The European Pillar of Social Rights was discussed, and ECD was mentioned as an important part of it, in the most recent European Union (EU) Council Recommendation. It builds the groundwork for lifelong learning in school (Council of the EU 2019). However, ECD curriculum implementation is frequently hampered by a lack of core management, which translates to a lack of clear-cut procedures in many activities, such as resource allocation.

Bertram and Pascal (2016:4) stated that different countries have implemented improvements to their early childhood systems, with a focus on enhanced training and school preparedness. Most European Union countries have extended access to the sector by introducing or revising their teacher education programs and curricula (OECD, 2015). Globally, ECE access is a challenge, with inadequate provision and significant disparities among countries with varying

degrees of development (UNESCO, 2019). It was important in this study to explore advantages and limitations of the updated ECD curriculum with emphasis on access to ICT.

According to several research, Indonesia's education system has issues with unequal access, low teacher quality, and poor infrastructure (Octarra &Hendriati, 2017). International organizations have exerted influence in local areas to benefit children and their families, as demonstrated in Early Childhood Development. The National Mid-Term Development Planning 2015-2019 in Indonesia aimed to enhance people's life in rural areas, where many ECE centres utilised recycled materials.

Considering the findings in Indonesia, it became imperative to investigate this aspect in Africa, particularly in Zimbabwean ECD centres. Ajuoga and Keta (2021) have noted that a number of African governments have introduced Competence Based Curriculum (CBC) in their countries. The aim of the CBC in both Rwanda and Kenya was to equip learners with hands on skills, instead of just concentrating on the academics. The new curriculum focusses on the success of each learner, it is child centred. The CBC is more efficient since the teacher is the facilitator of learning and not the provider of information.

However, one of the overarching impediments in African countries is the low teacher quality due to poor quality of training in ECD (Sooter, 2013). In Nigeria, Akinrotimi and Olowe (2016:35) observed that all instructors for ECD were not trained. In South Africa, the Western Cape Department of Social Development (WCDSD 2010) cited some challenges during implementation of ECD as; poor training of ECD teachers, poor infrastructure, lack of learning and teaching resources, non-availability of standardised curriculum, institutional barriers, and less involvement of the private sector. Ntumi (2016:56), highlighted that inadequate resources and infrastructure led to a host of other problems, such as hot sitting. To address the issue of poorly trained teachers, the New Zealand government retrained all teachers who had Primary School Teaching Diploma qualifications for three years in ECE (Rous 2004:20 in Modise 2017:45). In Zimbabwe, however, Dyanda and Dozva (2012) reported that ECD centres in primary schools were staffed by competent teachers with a Diploma in ECD. It was however imperative to find out if their qualifications enabled them to implement the updated curriculum effectively.

Although teachers were trained, Ngwenya (2019) reported factors such as human, physical, material, and financial resources as barriers to curriculum implementation. In a later study, Madondo (2020: 13) argued that lack of resources, infrastructure, ICT gadgets and skills, lack of support hindered successful curriculum implementation. According to Mupondi-Masuka, Nyika, and Kangai (2017), overcrowding is closely associated to high teacher-to-pupil ratios in Gweru urban schools, where teacher-to-pupil ratios were as high as 1:50, well beyond the government-mandated 1:20 ratio stated in Statutory Instrument 106 of 2005. Similarly, alarming levels of overcrowding with pupils ranging from 70-100 per class were noted in Kenya (Pale and Amukowa, 2020). Previously, Rose Odoyo (2015) had called for construction of additional classrooms to avert overcrowding. Rugare (2017) also observed large classes and congested timetables and their negative effect on teacher efficacy. In Kenya, Momanyi and Rop (2019) and Ondimu (2018) noted gaps during preparations of books and delays in publication of books and sometimes it was not easy to get books for a particular class. Rugare (2017) expressed similar thoughts, stating that the Ministry of Education had identified resources to be utilized under the new ECD curriculum, but that majority of the textbooks had not yet been published, making it impossible for teachers to follow the curriculum.

Notwithstanding what could be said about the lack of resources in developing countries, the change and innovation in those countries' education systems and curriculum implementation appear to be a universal practice in such countries as well. Zimbabwe is a developing country that looks to other countries for lessons on ECD curriculum implementation. The government's previous initiatives were mentioned. Whilst not taking away anything from previous research whether globally, regionally, or locally, it was necessary to critically analyse the current ECD programme and see if there are unique pros and cons influencing its implementation.

The Research Objectives and Questions

Some of the objectives which had to be achieved first were to:

- evaluate the social validity of the updated ECD curriculum
- determine advantages of the updated ECD curriculum
- determine limitations of the updated ECD curriculum
- analyse practitioners' views on implementing the updated ECD curriculum.

The central question was:

What are the advantages and limitations of implementing the updated ECD curriculum in Zimbabwe?

The following questions guided the study:

- How socially valid is the updated ECD curriculum?

- What are the advantages of the updated ECD curriculum?
- What are the limitations of the updated ECD curriculum?
- What are the effects of practitioners' views on implementing the updated curriculum?

Method

The study employed the qualitative research method which captures the nuances, subjectivities, and illustrative basis for participants' responses. Qualitative research seeks to understand a person's perspective of the world, from his or her own point of view (Creswell, 2014:205). The approach entails studying a phenomenon, in its natural context. It uses descriptive data in its research reports and the investigation is holistic. Through the qualitative approach, we interacted with DSIs, Heads of schools/TICs and ECD teachers and carried out lesson observations in the ECD departments. The decision to conduct research directly in schools helped to ensure that frontline stakeholders in ECD curriculum implementation could be reached. Data were collected through the qualitative approach, from the primary schools and Ministry of Education records.

Population and Sample of Study

Population refers to any group of people who share one or more qualities that the researcher is interested in (Best and Kahn, 2016: 13). Generally, this refers to all people, occasions or objects that can be involved in the study. Information obtained from District Office documents showed that the population of this study was 120 ECD teachers from 30 primary schools in EPMAFARA (Epworth, Mabvuku and Tafara) District of the Harare Metropolitan Province in Zimbabwe.

Purposive sampling, according to Oppong (2013), is a procedure in which a researcher selects participants who have expertise or experience with the issues under consideration. Purposive sampling was employed to select the subjects because of their accessibility and proximity to the researchers. The sample from the population consisted of eight (8) ECD instructors, four (4) Heads or TICs from four (4) schools, and two (2) District School Inspectors. The participants chosen in this study were knowledgeable about the phenomenon in question and were inclined to proffer relevant facts about the topic.

Table 1.

Practitioners' Profile

Pseudonym	Gender	Age	Teaching Experience	Qualifications
TRA1	Female	38 yrs.	10 yrs.	Diploma in ECD
TRA2	Female	32 yrs.	7 yrs.	Diploma in ECD
TRB1	Female	36 yrs.	7 yrs.	Diploma in ECD
TRB2	Male	37 yrs.	11 yrs.	Diploma in ECD
TRC1	Female	32 yrs.	3 yrs.	Diploma in ECD
TRC2	Female	36 yrs.	10 yrs.	Diploma in ECD
TRD1	Female	40 yrs.	10 yrs.	Diploma in ECD; Diploma in Planning
TRD2	Female	32 yrs.	4yrs	Diploma in ECD
Pseudonym	**Gender**	**Age**	**Teaching Experience**	**Qualifications**
TICA	Female	50 yrs.	21 yrs.	EC Infant
TICB	Female	45 yrs.	23 yrs.	Bed. ECD; EC Infant
TICC	Female	58 yrs.	31 yrs.	Bed. Management; CE General
D/HEAD	Male	48 yrs.	20 yrs.	BSc. PE; Diploma in Education
DSI1	Male	57 yrs.	25 yrs.	MEd Planning Admin & Policy Studies; Bed. Primary; CE
DSI2	Female	50 yrs.	25 yrs.	MEd Special needs ;Bed .Special needs; Diploma in Education (General)

Data Collection Tools

Data were gathered through in-depth interviews, instructional observations, and document analysis. The researchers administered the interview instruments personally and observed ECD teachers implementing the curriculum. This subjectivity involved in the selection and interpretation of qualitative research data made the process inductive rather than deductive as in quantitative research. Secondary data were gathered from records at District offices and schools thus, ECD department files and other teachers' class documents. This accomplished the process of triangulation.

The study was based on primary data collected through the descriptive case study. It allowed for the study of perceptions, feelings, values, views, and beliefs of the respondents. Case studies allow inferences to be made about a large group from data drawn on smaller number of individuals from that group (Yin, 2013:325). Therefore, the method has an advantage of breadth of scope. In a descriptive study, no attempt is made to change behaviour or conditions (Creswell, 2014). Thus, this research design ensured that the study became more realistic in that participants were studied in their natural settings.

The Validity and Reliability of the Study

Study credibility and trustworthiness determine the authenticity of the results and conclusions.

Validity; validity refers to how well the data acquired in the study accurately represents the study's variables. A purposive sample of the target population was used in this investigation. As well as content validity. The researchers utilized a panel of specialists to review the materials and assess their relevance to the research topic. The validity of this study was verified extensively by university colleagues in the ECD department and thesis supervisors. Their suggestions were incorporated into the software. The study's goal was to achieve high validity by reducing bias and employing a variety of techniques.

Reliability; when an instrument can reliably and consistently measure a variable and produce the same results over time, it is considered reliable (Creswell, 2013). Before the real research, a pilot test was conducted utilizing the interview schedules to ensure the tool's validity and dependability. The pilot accounted for 10% of the total sample size. Random sampling was used to conduct the pilot study in the study area. This assisted in identifying potential challenges that respondents might face, as well as determining whether the items in the research instrument would produce the data needed for the study.

Data Analysis and Interpretation

We employed NVivo software to analyse taped interviews and notes as suggested by Braun and Clarke (2013). We studied the data to find out the teachers' responses and reactions to the updated ECD curriculum implementation in the District. We transcribed and analysed data from interviews conducted and lesson observations, as well as documents using checklists with specific criteria to solicit views from District Schools Inspectors, ECD teachers, school heads or TICs. The data were presented on tables, figures, and diagrams. Verbatim quotes were presented for in-depth interview excerpts.

Results and Discussion

The results of this article were abstracted from the practitioners' views on the value and utility of the updated ECD curriculum. It was evident that the updated ECD curriculum has some advantages/ benefits as well as limitations/challenges. Lastly, the practitioners' views on curriculum implementation were discussed. The advantages of the updated ECD curriculum are explored first and these are summarised in the word cloud.

Figure 1.

Advantages of the Updated ECD Curriculum, Source: Own compilation from NVivo software

Advantages which came out from the study are clearly indicated on the word cloud. The most prominent are bolded namely: competence based, child centred, skills based, moving with times (i.e change), children's talents and others. The participants unanimously agreed that the updated curriculum brought about change which was beneficial to the learner. A cross section of participants identified fundamental factors that brought the changes in the curriculum. The practitioner TRD2 summarised the advantages of the updated ECD thus: *The updated curriculum is very good because it gives children life skills. They can earn a living through agriculture, drama, and theatre. They can be like Kapfupi (a comedian in Zimbabwe) or become commercial farmers.*

The updated curriculum is child centred and competence based. Overall, the participants celebrated the updated ECD curriculum in that it was hands on and matched well the 21st century expectations. DSI2 stated strongly, *the world has become dynamic; hence the new curriculum was adopted to ensure that the Zimbabwean education system is relevant to global norms.* The participants concurred that the curriculum was moving away from being subject oriented to skills oriented. This was further explained by TICC: *The learner can have skills identified at an early stage. Now we can identify the talents and skills in the learners unlike what used to happen in the old curriculum which focused on the academic.* The same observations were noted in Rwanda and Kenya by Ajuoga and Keta (2021). The ECD curriculum has been broadened to accommodate varied individual skills in children through additional disciplines such as ICT, VPA, Family and Heritage Studies, and Mass Displays. According to TRA1: *The new curriculum is now testing Music, Mass Displays, VPA so teachers will take all learning areas seriously.* This multiplicity is in line with Howard Gardner's theory of Multiple Intelligences.

Another advantage of this curriculum is that it is skills based as intimated by DSI1: *The thrust of the old curriculum was on academic education. This new one is hands on. It is skills oriented. It aims to produce a well-rounded individual, who is fully equipped when they leave school, even after Grade 7.* However, these skills were not fully developed due to shortage of resources. He also lamented on the unavailability of required materials as well as the need for teachers to undergo some relevant training, to competently implement the updated ECD curriculum.

Rous (2004:20) in Modise (2017:45) noted that the New Zealand government retrained all teachers who had Primary School Teaching Diploma qualifications for three years in ECE. In Nigeria, Akinrotimi and Olowe (2016:35) observed that all instructors for ECD were not trained. Contrary, in Zimbabwean Primary schools all ECD teachers hold a Diploma in ECD (Dyanda & Dozva, 2012). All what these teachers required was hands-on training in the actual teaching of new subjects like VPA, Mass Displays, and ICT.

DSI2 characterized curriculum change or moving with the times as an advantage of the new ECD curriculum: *This updated curriculum corresponds to the twenty-first century. It looks at the child holistically. Learners learn by doing while the teacher is the facilitator.* TICB defined the new curriculum as, *"moving with the times,"* implying that it is always changing, hands-on, and relevant to the twenty-first century. Participants generally agreed that the updated curriculum helps children in skills acquisition and development. It focuses on empowering learners with self-help skills and children can earn a living through these skills. TRC2 also echoed that: *Learners are exposed to contemporary world through ICT.* The pressure was on teachers who ought to become conversant with technology which is inherent in children naturally. Arthur (2017) pointed out the importance of equipping teachers with ICT skills. Because youngsters are born in the age of the internet, teachers must keep up with the latest trends and provide opportunities for students to showcase their abilities.

The promotion of good health and 'ubuntu' was another advantage of the updated ECD curriculum. TRC2 stated this point concisely in the following excerpt: *PE is beneficial to one's health.* Children's health is promoted through subjects such as PE, Mass displays and VPA, but the teacher bemoaned on the scarcity of learning materials in these areas. It is prudent for teachers to be creative and improvise some teaching and learning materials. In Family and Heritage studies, for example, new sections in the curriculum emphasize Ubuntu/Hunhu and decision-making. These findings were also coupled with some limitations discussed in the following paragraphs.

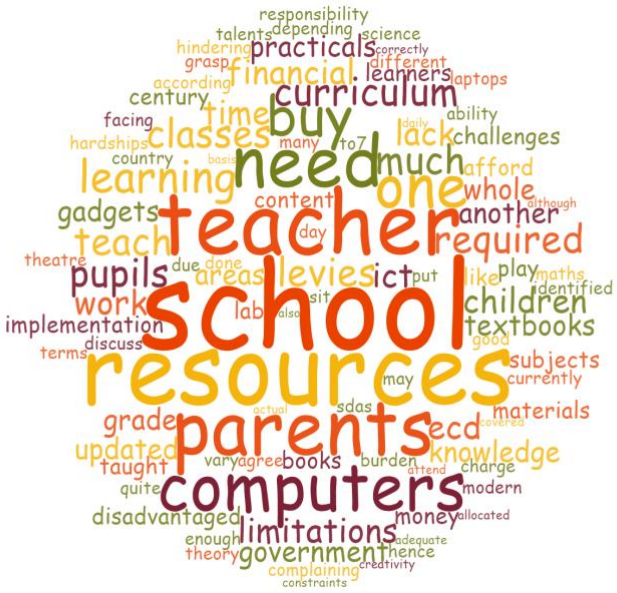

Figure 2.

Limitations of the Updated ECD Curriculum, Source: Own compilation from NVivo software

Limitations identified during curriculum implementation in EPMAFARA District include excessive workload for learners, financial and resource constraints, ICT needs, infrastructure, and high teacher-pupil ratio. The conclusions are supported and illustrated further by excerpts from participants, such as TICA's lament: *The limitations include that most schools were not prepared because it was a new concept. We don't have the funds to purchase textbooks. The curriculum's implementation is hampered by a lack of resources.* The next paragraphs go over the constraints in more detail.

Participants identified excessive workload for learners as one of the limitations as highlighted by TICB: *The work is too much. The subjects are too many to be done daily (8 learning areas). Children cannot grasp all the subjects in 20 minutes, the time is short for children to grasp the content.* The timetable was found to be congested and the work was too much for ECD pupils to do in one day. Rugare (2017), who witnessed huge classes and congested timetables and how they severely affected children' learning, also mentioned this restriction.

Another area which lent itself to analysis was the financial and material constraints. Pursuant to the issue of limitations, DSI1 lamented: *Teachers must undergo some updated sessions of training. Some schools cannot buy the required materials and gadgets to be used in the implementation of the updated curriculum. This is due to financial constraints.* Okinrotimi and Olowe (2016:34), have noticed the issue of resource scarcity. DSI1 further revealed that the government has shifted the burden of providing resources to the schools and parents.

In this study, the ubiquitous role of resources was felt across all the schools. Scarcity of textbooks was evident at all schools but more so at school A. Five classes, each with an average of 65 students, shared ten textbooks, according to TICA. Musengi (2013) described a similar situation in which teachers in several schools were forced to share a single textbook while teaching various classes. Rugare (2017), also noted that the Ministry of education had identified materials that are to be used in the updated ECD curriculum but most of the textbooks had not even been published then, thus incapacitating teachers to implement the updated curriculum efficiently. In Kenya, Pale and Amukowa (2020) also noted great scarcity of relevant books as well as teaching and learning media.

The shortage of ICT gadgets came out prominently as one of the limitations. At District level. DSI 2 had this to say*: Learning in the 21stCentury needs resources like ICT gadgets. Most of our parents cannot afford to buy the required resources for learners.* Where the provisions lack, the effectiveness of learning suffers. At school A, ECD classes to Grade 3 pupils did not do ICT practicals, only Grades 4 to 7 do ICT practicals. There was only one ICT teacher for all the junior classes and the school had forty classes. Therefore, Arthur (2017) suggested training of teachers in the use of technology.

Generally, all schools under study did not have computer labs for ECD pupils as well as the required ICT gadgets. Furthermore, the country was under extraordinary load shedding. The power outages negatively affected practical ICT learning in all schools. Most of the schools in EPMAFARA district are in disadvantaged areas and most parents cannot afford to pay for generators or Solar.

One proxy measure of a school's level of development is the level of infrastructural provision. Issues of infrastructure that are central to curriculum implementation and inadequacy or provision in pitiable state obviously affects teacher morale. The issue of infrastructure came out in response to the question on limitations of the updated

ECD curriculum implementation. The following sentence presents the verbatim utterances of TRC1: *Infrastructure and time are not adequate for learners. This results in too much paperwork.* Ntumi (2016:56) agreed that resources and infrastructure were insufficient and inadequate for learners. Lack of infrastructure led to hot sitting in all primary schools in EPMAFARA district. Scarcity of classrooms and proper furniture obstructs effective learning.

Overcrowding which was prevalent in the district put so much physical pressure on children who struggled to pay attention during lessons. It is cruel to make the children learn in such poor conditions. We call for construction of additional classrooms to avert overcrowding as suggested by Rose Odoyo (2015) in Kenya. The participants in this study all alluded to the need for more classrooms to avert overcrowding and hot sitting. Some teachers also complained about too much paperwork and inadequate time for all the subjects on the timetable. It is our contention that Schools Development Committees (SDCs) should prioritise building ECD blocks in all the schools under study. The EPMAFARA district had a high teacher-to-pupil ratio of 1:50 to 1:80, which rendered instructors ineffective because they couldn't provide each child personalized attention. Higher teacher-to-pupil ratios reduced instructors' ability to teach.

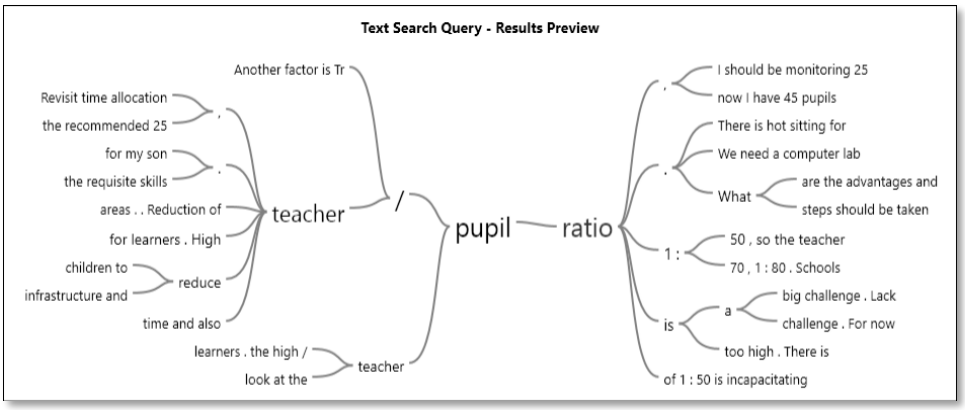

Figure 3.

Teacher to Pupil Ratio, Source: Own compilation from NVivo software

The tree diagram summarises the teachers' responses with regards to teacher -pupil ratio in the schools studied. In Zimbabwean primary schools, the teacher- pupil ratio for ECD classes is above 1:50 contrary to 1:20 stipulated in Director's Circular No. 12 of 2005. An effort should be made to ensure that there is a more equitable distribution of school enrolments so that classes do not become too small to be viable, or too large to be managed. Connected to enrolments are the teachers' pedagogical skills.

It emerged from the responses that the majority of facilitators lacked knowledge in handling the program. TRB2 summarized this as follows: *Facilitators lack sufficient expertise of how to deliver the new ECD program. There is need for them to have more workshops. No learning through play. There is need for learners to have free play. There should be creativity.* Some teachers lacked knowledge of topics, such as, Theatre in VPA. TRA2 further expressed this by saying*: Also, we lack knowledge, for example at this school we do not have a theatre, and learners have no idea of a theatre.* Not much was being done in ICT due to lack of ICT gadgets, electricity, and lack of knowledge on the part of teachers.

Repetition of topics came up as another limitation. TRA1 explained that*: There is repetition of topics in different subjects.* From the teacher's response, the general view is that the content is too much and there is a lot of repetition of topics in different subjects as alluded to earlier on. Topics like Balances, Coordination and Movement are repeated in PE, VPA and Mass Displays. Colours and Shapes are repeated in Mass Displays, Maths/ Science and English. Human body parts are also repeated in many subjects.

Teachers taught the topics individually, as indicated in the subject syllabuses and on the timetable, according to an investigation into this matter of subject integration. We believe that if the syllabuses are correctly aligned, children will have free time on the schedule to play. The fact that teachers complained about issues being repeated shows that they require coaching and mentoring, which is the responsibility of school administrators and TICs. It also demonstrates the teachers' lack of imagination and inventiveness. Teachers, as a result, require extensive hands-on training to master the strategies that can be used successfully, particularly in topic integration. There may be need to revisit the syllabi and ensure the topics are well structured to avoid unnecessary repetition of topics, which is currently evident in the syllabuses and scheme cum plans.

To address the issue of congested timetables and too much subject content, other teachers expressed that they take time from 'less important' subjects to do the ones they deem 'more important as put across by TRD2: Sometimes I take time from *P.E. and I use it for Languages and Maths. The content is too much; it cannot be done in 20 minutes.* This contrasts

with Howard Gardner's Multiple Intelligence theory which equally values all subjects. TRC2 thinks that time is adequate but there is need for more time for ICT. Teacher-pupil ratio should be in line with the time allocated so that the teacher can attend to individual children. In this study, the ratios were too high, up to 65/80 pupils per class.

Conclusion

The aim of the study was to analyse the implementation of the updated ECD curriculum in Zimbabwean primary schools. The article first presented the purpose of education reforms highlighting the rationale of the study. The study determined social validity by identifying the social significant outcomes of the updated ECD curriculum. It then explored the pros and cons that arose during the implementation process defined by the practitioners' views like the competence-based component, child centred approaches etc. However, the implementation of the ECD updated curriculum still has some pertinent disadvantages like, lack of support, lack of learning and teaching materials, enormous teacher: pupil ratio, heavy workload and lack of ICT skills. The paper also exposed how the top-bottom management by Education authorities which lacks consent and consultations can work against good intentions envisaged in the updated curriculum. In general, the quality of ECD is still on the lower side compared to teachers' expectations. The Ministry of Education still needs to collaborate with interested partners in improving access and participation of children to ECD. Additionally, it is critical that quality results of the updated curriculum are also addressed. Practitioners felt that the curriculum was socially relevant although there are strategical gaps to be rectified.

Recommendations

Curriculum blueprints that ignore teachers' welfare are likely to fail. The school must play its crucial role by creating an environment that caters for teachers' and children's needs and interests. Schools in the district lacked proper infrastructure and human resources, in terms of subject specialist teachers. The school and their School Development Committees should spruce up infrastructure and support training of specialist teachers. The members of the school administration should conduct classroom supervision to "catch up" with changes in the system. There is need to organize fundraising programmes to generate money which can be used for seminars and purchase of learning materials.

The environment at any school has a bearing on curriculum implementation. The school community should take an active role in educating children and advocating the adoption of the ECD curriculum in primary schools. They should chip in towards construction and furnishing of ECD classrooms. Schools must provide e-learning to pupils. Communities should support schools with requisite resources.

Limitations of the Study

The COVID-19 pandemic was the largest stumbling block declared by WHO, on March 11, 2020, in Zimbabwe. Out of the five sampled primary schools only four participated in the study due to the closure of schools. We did not have enough time to make observations in all selected schools as desired. Time was quite limited. The research participants were equally affected and might have been affected on clearly articulating their expectations. Another challenge was the limited related local research material on the topic. Because only Harare primary schools were involved in the study, the findings may not be applicable to other primary schools in Zimbabwe, but they do provide insight into the kind of challenges that may arise in curriculum implementation throughout the country.

Acknowledgement

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Biodata of Author

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Appendix 1.

Interview Guide For Practitioners

The researchers will explain to the participants that Mrs H.P. Muzembe is a PhD student at the University of South Africa (UNISA), Dr M.M. Machaba and Dr M.R. Modise are Senior lecturers in the Department of Early Childhood Development at UNISA and are conducting a study on; **Implementing the updated Early Childhood Development curriculum in Zimbabwean primary schools: Social Validity Based on Practitioners' Views.** Permission has been sought and granted by the Ministry of Primary and Secondary Education, Provincial Education Directors, District Schools Inspectors, and Heads of schools from EPMAFARA district. Confidentiality will be observed as we review your responses.

Q1. Which factors affect ECD curriculum implementation?
Q2. What are the advantages of the updated ECD curriculum?
Q3. What are the limitations of implementing the updated ECD curriculum?
Q4. What are your expectations in implementing the updated ECD curriculum?
Q5. What are your views on the preparedness of schools regarding this program?
Q6. What are your recommendations on ECD curriculum implementation?

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