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Learning Number Concept Integers Using Preferred Contexts: The Use of Contexts Facilitates the Learning of the Number Context Integers in the Intermediate Phase Classroom

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Abstract

The purpose of this paper was to investigate the preferred contexts in learning number concepts in integers. The research also looked at the impact of contexts in the interpretation of the integer using stories. The researcher decided to interrogate and find out if the use of contexts could enhance the learners' academic performances. The problem is the intermediate phase learners are operating two grade levels behind the expected and South African intermediate phase learners are performing poorly in Mathematics. The scope is on focus relevance, appropriateness, and correctness in the development of mathematical thinking and practice. The argument is the use of contexts in learning number concepts can facilitate the understanding of the learning of the number concept integers. Discussions on different contexts for learning integers were done by intermediate phase learners (Grade 4-6) in one primary school in Johannesburg North in Gauteng Province. Interviews on preferred contexts in learning number concept integers comprised 29 learners. The research adopted a qualitative approach of analyzing the interview responses from the learners. Analysis of results indicates that the use of preferred contexts in learning number concepts in contexts can either facilitate or hinder the learning of number concepts in integers in the intermediate phase. The findings imply that the use of contexts has a positive or a negative impact on the learning of number concepts in context integers. These results can be generalized to all the other learners who are in the same phase.

Keywords: Integers • Context • Mathematics • Legitimacy • Education stakeholders

Introduction

The use of contexts in learning mathematics has been explored by different researchers [1,2]. Different researchers have come up with different contexts but the question remains which context is the best for which learner at which level. Research on contexts was done elsewhere but very few researchers have explored the intermediate phase in preferred contexts in learning of concepts of integers. The research on preferred context is not new in the field of education. It was previously carried out by Julies et al. [3]. Bofferding [4] investigated first graders' mental contexts when encountering questions about negative integer values, order, and directed magnitudes. There is a gap in literature relating to the intermediate phase, so this paper maps the literature gap that your work aims to fill the gap by constructing the literature based on the topic integers. The study seeks to address three problems firstly the intermediate phase learner's poor performance in South Africa in contexts, the study answers the question: What are the preferred contexts in learning number concept integers in the intermediate phase? Secondly, the learners see, identify and understand mathematical ideas in contexts that they prefer, and thirdly the curriculum, number concept contains most of the weighting in the content in learning mathematics. Department of Education [5] is attended to and the results are improved because Mathematics continues to be the most underperformed subject in South Africa with an average of 52.7% pass percentage in the past five years nationally and a significantly low percentage of 35.5% pass in the Gauteng Province. Researchers have never agreed on which context the best in learning integers is.

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Literature review and theoretical framework

The number concept is the most loaded section of the Mathematics curriculum as seen on the weighting table and it covers 50% of the weighting, however, research findings indicate learners' poor grasping of the basics number concepts in the South African Curriculum assessment policy statement. Learners are found to be having problems in dealing with contexts in real-life situations. Educators have started to argue that some contexts are better than others and then the argument is which then can be the most preferred contexts in learning number concepts integers? The South African teaching and learning seem to be teacher-centered because learners do not seem to be acquiring the benefits of the basics of education [6].

Many education systems including South Africa do not provide adequate learning opportunities to learners. Learners have limited contexts to learning concepts and this affects their skills and motivation in learning and develops into mature mathematicians who can cope with the advanced academic work into the senior phase and the secondary schools. Integers are very important in the future lives of learners as they will impact the understanding of algebra which is a branch of mathematics. Many researchers have studied the history and development of integers by earlier mathematicians sees for example [7-11] but a consensus on which is the best context has not been reached.

Research has outlined two major categories for learning integers

According to studies, there are two major contexts for integer instruction, namely, counters and number line [12], and these two categories have guided the learning of integers in all phases. The two major contexts the neutralization (counting) and the number line (directional) contexts and all other sub-contexts falls under these major contexts.

The idea that the contexts can be used in and for teaching and is not new; it has been discussed, debated, and researched for at least two decades now. Many researchers have investigated the use of contexts in learning number concepts in integers [13]. Much is known about the learning and teachings of number concepts in integers, for example, Whitacre compares the integers across the grades and finds out the justifications from the

learners [13]. The topic "Preferred contexts in learning number concepts in contexts integers in the intermediate phase in Johannesburg North District pilot study", examines the use of contexts in a pilot study and explores the benefits of using such studies.

It is believed that almost every day, learners have interacted with negative and positive numbers and can contextualize for example the context of temperature, altitude, and money [14]. The idea of using contexts is supported by Liebeck [15] who maintains that having a context as a starting point is particularly important and Van de Walle [14] suggests that a number line is one of the many contexts that are linear and works as a good tool for learning operations. Shanty [16] proposes the context of the thermometer as the starting point. The above two have the same context as a starting point since the thermometer uses the basic principles of the number line as argued by Stephan and Akyuz [17]. The study of contexts [12] used two-colored counters, white as positive and red as negative numbers.

Recent research has shown the use of games in learning number concepts integers [18] use mathematics tasks in the Asian games for learning. The use of games was also used by Efriani et al. [19] used the sailing context. The used game is supported by Jannah et al. [18] who use soft tennis and volleyball in mathematics problems.

Although there can be arguments on the nature of contexts to be used in learning and teaching integers, research has shown that the use of contexts has several advantages over disadvantages in learning number concepts. There is convincing evidence through literature that contexts can be useful in learning integers but the question of which contexts should be followed remains a point of research.

The Neutralization contexts that are explored in this study are:

- The opposite integer context
- Use of chips
- Use of charges
- Happy and sad faces
- Cancellation context
- The contexts of games

The number line contexts that are explored in this study are:

- The number line as a tool for operations
- The context of temperature as it uses the number line
- The contexts of altitude
- The dream mall (Vertical number line)
- The Context of sea level
- The context of the Historical Timelines

My research question is "What are the preferred contexts in learning number concepts in integers?" and "Why do these learners prefer these contexts?"

Theoretical framework

A theoretical framework is a structure that summarizes concepts and theories, which you develop from previously tested and published knowledge which you help have a theoretical background [20]. The definition of the theoretical framework is given by Swanson [21] who asserts that it is a structure that can hold and support a theory of study. The theoretical framework is a combination of all theories or one main theory summary of your thoughts on your research. The researcher understands the theories of the giants in the field of study as they relate to this study. The theoretical framework is viewed by leaders say, helps to develop an informed, and specialized lens, through which you examine data, conduct data analysis, interpret the findings, discuss them and even make recommendations and conclusions.

The theoretical underpinning of the study is that mathematical knowledge for teaching is situated in the practice of teaching [20] which focused on active learning in a constructivist classroom and what they prefer to learn and how it would affect the learning results. A theoretical framework has been described by different researchers. Grant et al. define theoretical framework as a "blue" print for research [22]. A theoretical framework is based on an existing theory in a field of inquiry that is related to the hypothesis of a study. It is "borrowed" by the researcher to carry out his inquiry. The framework is believed to provide the foundation upon which research is constructed. In this paper, all aspects of the paper are connected to the theoretical frame as advised by Ravitch and Carl [23] and they allude theoretical framework assists the researchers in situating and contextualizing formal theories as a study guide. Preferred contexts in learning number concepts in integers rest its principles on active learning in a constructivist classroom, in a cyclic formation focusing on the learner, learning strategies, teacher as the facilitator, assessment, and reporting within a classroom and learning environment [24]. How do the learners in the intermediate phase prefer to be taught number concepts integers? Kivunja [25] proposes that in a constructivist classroom, active learning takes place and a highly dynamic teaching and learning environment are created. Learners are busy and actively constructing their understanding. Learners are allowed to choose, do and review the activities and concepts they learn. Learners participate in learning activities as partners in knowledge construction working with integers. The study allows the learners to learn integers using learner-centered, providing scaffolding strategies used by the teacher involved in the study.

Conceptual framework: The study preferred contexts in learning number concepts integers followed the study guidelines of Julie [26] and his allies in trying to find the ways of improving the South African learner in Mathematical context learning.

The research paradigm

Before the 1980s, the popular research methodology was the quantitative approach which originated in the natural sciences and was concerned with investigating things that could be observed in some way [27]. The quantitative research was then accepted as a research paradigm in educational research and the argument was which paradigm is better than the other between qualitative and quantitative? Many quantitative and qualitative researchers argued that their approach was superior. In the 1990s the paradigm wars reached the peak of the advocates of the quantitative approach versus the advocates of the qualitative research [28]. The choice of the research methodology that will guide the research as a research paradigm. The research methodology follows a paradigm, the term paradigm originated from the Greek word paradeigma which means pattern and was first coined by the French philosopher Thomas Kuhn in 1962 to denote a conceptual framework shared by a community of scientists which provided a convenient model for examining problems and finding solutions. The theory of paradigms is supported by Terre Blanche and Durrheim who maintain that the research process has three major dimensions: Ontology, Epistemology, and methodology. Research has shown that there are two types of paradigms positivism and the most popular are qualitative methodology, which is grounded on the interpretivism paradigm, and quantitative approach which is on the positivist paradigm. The research methods followed in this study will be qualitative research approach or paradigm.

Ontological issues on educational research: Ontology refers to a branch of philosophy concerned with articulating of nature and structure of the world. It specifies the form and nature of reality and what can be known about it. Neuman [29] argues that there are two broad contrasting positions-objectivism and constructivism: Objectivism holds that there is an independent reality and constructivism that assumes that reality is a product of social processes.

Many researchers have explored the work of paradigms in research [30,31]. According to these two above a research paradigm an all-encompassing system of interrelated practice and thinking that defines the

nature of inquiry along these three dimensions. Most researchers argue the importance of ontology, epistemology, and methodology. Lincoln et al. [32] stated that a research paradigm is intrinsically associated with the concepts of ontology (the way the researcher defines the truth and reality, epistemology (the process in which the researcher comes to reality), and methodology (the method used to conduct the investigation). In this research, the answer to the questions regarding these three elements provides the interpretive framework that guides the process including the strategies, methods, and analysis of the topic, "Teachers' experience of technology as a developer of mathematics inclusive education in the intermediate phase in primary schools in South Africa."

The term ontology is from a Greek word (onto, which means "being or logia" which means the scientific study or theory. According to Wand and Weber, ontology is a branch of philosophy concerned with the articulation of nature and the structure of the world [33].

The study will follow the positivist paradigm which explores the social reality that is based on the philosophical ideas of the French philosopher August Compte (1798-1857) who formulated the doctrine of positivism. His ideas were also fundamental in the development of sociology. This section outlined ontological on educational issues and the next section refers to the methodology.

Statement problem

The use of contexts has also been a theme in the Relevance of Mathematics in Education project. The ROSME in Julies project provided information on what learners in different parts of the world would prefer as contexts for learning [3]. Research under this then has included [34-39]. These researchers investigated the preferred contexts in teaching and learning. This study builds on the findings from these researchers. However, the focus here is to investigate contexts that learners in the intermediate phase prefer to use when interpreting and solving problems that involve number concepts.

Methodology

The study has been done in three phases to explore all two critical questions, the first phase involved the preferred contexts in learning number concepts integers in the context in the intermediate phase and the reasons why the learners would prefer those contexts. Thirdly the paper analyses the way the intermediate phase learners interpret the given integer statements using stories of addition and subtraction [40]. This involved interviewing intermediate phase learners at a primary school in Johannesburg North District in Gauteng Province. Before the main study, a pilot study was carried out by Fraser et al. [41] who is supported by Doody [42] who maintain that pilot studies are very essential before carrying out the main study. The study preferred contexts in learning number concepts in integers in Johannesburg North District had a sample of 29 learners and 6 learners were involved in the pilot study.

The study collected qualitative data. Data were collected from the intermediate phase (Grades 4-6) from one school in Johannesburg North District in Gauteng Province in South Africa using semi-structured interviews. Learners from this phase were from low and middle socio-economic home backgrounds. Twenty-nine learners were interviewed and the responses were transcribed by the researcher. The data was collected in 2019 during the second and third terms. The number of interviews was N=29. Learners were presented with different learning contexts for integers. They were asked to identify the preferred contexts in learning number concept integers. They were also asked to interpret two given integer problems using their preferred contexts as follows:

- +2-7=
- +7-20=

The data was from the interview were entered into an excel spreadsheet and analyzed for relevance, appropriateness, correctness, and ability to interpret the given statement.

This section outlined the methodology the next section focuses on the ethical considerations.

Ethical considerations

Several ethical considerations were undertaken when conducting the study from which the article was taken [40]. Ethical clearances were granted from the Department of Education District Office June 2019 reference (8/4/4/1/2) to establish the community engagement project. Learners sampled from this project were sampled from a Johannesburg school. Further consent was granted from the same office to research preferred contexts in concepts. At the school level permission was granted to the principal parents and learners for participating learners. Parents signed consent forms to accept participation in the study. They are however free to withdraw from the study any time they felt compelled to do so. Participating learners were assured confidentiality of the findings and their identity would not be revealed at any point. In analyzing the responses, the learners were given pseudonyms. The ethics committee of the Tshwane University approved data in the sampled school.

Preferred contexts in learning number concepts integers

The questions that learners responded to in the interview had three sections connected to integer concepts. These questions were designed by the researcher with the help of the supervisors and trying them for a pilot study. In choosing the questions the researcher ensured that the numbers and the language used were at the level of the learners. Using numbers below 30 facilitated the understanding of the mathematical concept to be captured in the interviews.

In the interviews that the learners had, Learners were asked to identify number contexts they prefer to learn number concepts in integers. They were asked why they preferred these number contexts in learning the number concept integers. The last question they answered was to write a story to interpret the given integer statements. The results were transcribed and sorted then analyzed using excel. The next section shows the findings of the research.

Result and Discussion

The detailed findings of this research have been presented elsewhere [40]. In this paper, the focus is on the data from the 29 learners who participated in the interviews and provided excerpts and interpretations of the two given integer statements. This focus is intended to illustrate in some detail what we can learn about students' understanding of specific concepts in integers. The interpretation consists of sections under the term integers calculation and related story interpretation of the two given integer number operations. Table 1 shows the preferred in the number context integers, Table 2 shows the reasons for the preferred contexts and 6.0 shows the contexts used according to total occurrences.

Finding 1

Some of the intermediate phase learners preferred certain contexts in learning the number concept integers. The findings show that children prefer to learn number concepts integers using preferred contexts. The most preferred context in learning number concepts in integers is the context of the number line (28%) followed by the contexts of neutralization (Happy faces 17%) followed by the context of Temperature (14%). The findings show that the learners who preferred to learn the concepts in integers using the context of altitude (steps and stairs) constituted (11%) and the contexts of song, game, and story obtained (10%) each. The major finding is the learners in the intermediate phase prefer to learn number concepts in context integers in preferred contexts see Table 1 below.

Finding 2

The findings indicate that the majority of the intermediate phase learners preferred to learn the number concept integers using contexts for reasons.

The findings show that the majority of the intermediate phase learners (55%) preferred to learn the number concepts integers in the preferred contexts because the context of learning is easy, is fun (10%), understand (10%), and was fun (10%). The findings also show that the intermediate phase learners preferred to learner the number concept integers because it was better for them (3%), wanted to know what comes below zero (3%), because they what to be journalists (3%), want to be clever (3%), better to learn spellings(3%) and has more to learn(3%). The summary of the findings and the reasons provided are shown in Table 2 below.

Finding 3

The findings show that in the majority (52%) of the intermediate phase learners it is clear that the use of contexts facilitates the learning of the number of contexts integers in question 1 see Table 3 below.

The findings show that in the majority (62%) of the intermediate phase learners it is clear that the use of contexts facilitates the learning of the number of contexts integers in question 2 see Table 4 below.

The findings show in two separate cases the intermediate phase that the use of context facilitates the learning of number concepts integers in context.

Table 1. Preferred contexts in learning the number context integers (sorted according to percentages).

Preferred contexts	Percentage
Number line	28%
Happy faces	17%
Temperature	14%
Stairs/steps	11%
Songs	10%
Game	10%
Story	10%
Total	100%

Table 2. The reasons for the preferred contexts for learning number concept integers are sorted in order of percentages (sorted from the highest to the lowest).

Reasons	Percentages
Easy	55%
Understand	10%
Fun	10%
Better for me	7%
Can learn what comes below zero	3%
Because I want to be an author/journalist	3%
Makes me clever	3%
Better for me to learn spellings	3%
More to learn	3%

Table 3. Ability to facilitate learning using contexts for question 1.

Able or unable	Number of learners	Percentage
Able	15	52%
Unable	14	48%
Total	29	100%

Table 4. Ability to facilitate learning using contexts for question 2.

Able or unable	Number of learners	Percentage
Able	18	62%
Unable	11	38%
Total	29	100%

Table 5. The most preferred contexts in learning number concepts in contexts in integers, most popular texts.

Preferred contexts	Percentage
Number line	28%
Happy faces	17%
Temperature	14%

Finding 4

The findings show that the use of contexts can derail the learning of integers following the preferred contexts. Some of the learners (48% in question 1 and 38% in question 2) find the use of the contexts derailing the learning of the positive and negative numbers question 1. This is the group that was unable to interpret the given statement. The total findings also reveal that 44% of the learners were unable to interpret the given number concepts in integers they were unable to interpret the given statements.

Finding 5

The use of contexts has a double effect on some intermediate phase learners. It is clear from the findings that the use of the contexts can have a double effect: In one aspect, the help of the context, in the other part, they have negative effects. They used the relevant context, correct calculations but adding a new number in the analysis offsetting the final answer. The context was inconsistent, relevant, not appropriate, and she was unable to interpret the original statement using the preferred context.

Conclusion

In this article, I found out that the use of preferred contexts in learning number concepts integers can facilitate the learning of the number concepts in integers since for question one and question two the majority of the learners can interpret the given integer statements. Although the use of contexts proved to facilitate the learning and interpreting of the number concepts in integers the results showed that different contexts are preferred by the intermediate learners in learning number concepts integers.

This study showed that the intermediate phase learners prefer to learn number concepts integer using the number line contexts with 28% followed by the happy face 17% and the contexts of temperature as shown in Table 5 below. These were the most popular contexts as preferred by the intermediate phase learners.

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