TEACHERS 'VIEWS ON THE EXTENT OF BASIC OPERATIONS GAMES' USAGE FOR ENHANCING DEVELOPMENT OF LEARNERS' MATHEMATICAL LANGUAGE: CASE OF MOCHUDI PRIMARY SCHOOLS.

By

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APPROVAL

This research essay has been examined and approved as meeting the required standards of scholarship for partial fulfilment of the requirement for the Master of Education Degree (Mathematics Education).

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STATEMENT OF ORIGINALITY

I declare that I submitted a research essay entitled, "Primary School teachers 'views on the extent to which basic operations-games enhance the acquisition of the learners' mathematical language: "Case of Mochudi Primary Schools," which I completed at the University of Botswana between May 2017 and May 2019. It is my own work, except where reference is made. This work has never been submitted for the award of any other degree of any university.

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Student Date

DEDICATION

I dedicate this piece of work to my late sister, Mmaleepi Nditi who passed away in 2015. I have indeed lost a sister, a mother, a friend and a mentor not only in academics but in all the aspects of life. May her soul rest in peace!

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ABSTRACT

The purpose of this research was to investigate primary school teachers' views on the extent to which basic operations games are used to enhance learners' development of the mathematical language.Research has shown that learners' performance in mathematics improves when games are used to teach the subject. Data for this study was collected from Mochudi primary schools. Questionnaires and interviews were used to collect this data. Sixty three primary school teachers answered a questionnaire while eleven Heads of Departments were interviewed. A mixed method designwas then used to analyse data. The results of this study revealed that primary school teachers in Mochudi rarely use basic operations games to teach mathematics. Reasons for usage and non-usage of basic operations games in mathematics teaching were also revealed. Teachers use basic operations games to arouse learner interest and also to make mathematics lessons learner centred. Reasons for not using basic operations games were that schools do not have resources required to play games and also that games are time consuming.This suggests that primary school teachers should be supported andencouraged to use basic operations games to teach mathematics. The Ministry of Basic education should emphasize game enhanced learning in primary schools and also provide resources necessary for learners to use during gaming.

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LIST OF ABBREVIATIONS AND ACRONYMS

BEC	Botswana Examination Council
CD&E	Curriculum Development and Evaluation
DPE	Diploma in Primary Education
HODs	Heads of Departments
ICT	Information and Communications Technology
IMU	International Mathematics Union
MOBE	Ministry of Basic Education
MOE	Ministry of Education
NIE	National Institute of Education
PTA	Parents and Teachers Association
PSLE	Primary School Leaving Examinations
TIMSS	Trends in International Mathematics and Science Study
USA	United States of America

CHAPTER ONE
INTRODUCTION

This chapter is an overview of the study which seeks to investigate primary school teachers' views on the extent to which basic operations-games are used in primary schools to enhance the development of mathematical language. In this chapter, the background of the study is presented, followed by statement of the problem, motivation of the study, purpose of the study, research questions, significance of the study, delimitations of the study, theoretical framework and definitions of terms as well as the organization of the research essay.

1.1 Background of the Study

In mathematics, the four basic operations are addition, subtraction, multiplication and division. These operations were not taught to primary school learners in ancient times because they were seen to be very complex. This is why many learners of that time could not add up or use calculating tables and counting materials such as abacus (Costa, 2014). According to Costa, Pestalozzi was the first person to introduce the teaching of operations to young children aged six or seven years at the beginning of the nineteenth century.

Nowadays, basic operations are taught at all levels in the primary schools globally. In the United States of America (USA) and Korea, mathematics syllabi cover all the four basic operations across all the elementary grades. The curriculum also advocates for the use of learner centred strategies (Ferreras, Kessel & Hi-Kim, 2015). Similarly, the national curriculum in England emphasizes the teaching of basic operations in all the primary school grades. The complexity of the syllabus objectives on these operations differs with the grades. The use of games in mathematics teaching is also emphasized (Department of Education,

2013). This implies that most European countries emphasize the teaching of basic operations from grass root level through all standards in elementary schools.

Ohuche (2012)states that, participants who represented their respective countries in the International Seminar on Developing Mathematics in Third world countries held in Khartoum in 1978, agreed that arithmetic operations should be taught at all grades in the primary schools. African countries were represented at this seminar and Ohuche asserted that most of the mathematics curricular in the African states emphasize the teaching of arithmetic operations. This implies that basic operations appears in the mathematics curricular of most African countries and are taught at all levels of primary education.

Kazima (2013) whose study focused on the 'Universal basic education and the provision of quality mathematics in Southern Africa' revealed that arithmetic operations are included in the primary school mathematics curricular of most Southern African countries. This means primary school learners in these countries are taught basic operations. Kazima also revealed that the mathematics curricular for countries of Southern Africa advocate for the use of learner centred approaches in mathematics. This means that mathematics teachers in Southern African countries are encouraged to use strategies in which learners have maximal participation in mathematics lessons. Usage of basic operations games as a learner centred approach in mathematics teaching is advocated for by this study.

Freitag (2013) contends that basic operations are very crucial to mathematics learning because most of the mathematics concepts taught at primary schools centre around basic operations. This indicates that without the knowledge of basic operations, primary school learners are less likely to master many mathematics topics.According to Kazima (2013) most of the primary school learners in Southern African countries did not show mastery in the application of arithmetic operations. Kazima contends that learners do not perform well in most mathematics topics if they had not mastered basic operations. This indicates that

something has to be done to help learners to master basic operations which are a foundation for learning other mathematics topics. This study encourages mathematics teachers to use basic operations games to teach both the operations and the mathematics concepts.

1.1.1 Current mathematics syllabus used in Botswana primary schools

The current Botswana primary school mathematics syllabus has included the basic operations topic in all the standards, implying that the topic has to be taught at all levels. The syllabus is also spiral. The topics in it filter to all standards and what differs is the level of complexity of these topics at the different standards.

The mathematics syllabus stipulates the topic, its general objective and its specific objectives. The syllabus also has activities and instructional strategies that are suggested to teachers (Curriculum Development and Evaluation [CD&E], 2005). It is not compulsory for teachers to use the suggested strategies. In other words, teachers are at liberty to implement their own strategies. It is assumed that through teacher preparation, teachers can actualise the demands of the curriculum as opposed to being too prescriptive. A notable issue is that the primary mathematics syllabus in its rationale promotes active participation, in which a teacher has to map-up the required level of operation (CD&E).

According to Lampen (2015) mathematics syllabuses should emphasize the use of teaching strategies that make learners to play active roles in the mathematics lessons. As they do so, they would be able to find answers for themselves. Rutherford (2015) follows the same sentiments as she advocates for the use of games in mathematics teaching.This indicates that games such as basic operations games are likely to enhance the learning of mathematics concepts faster because learners will be discovering answers for themselves. When learners discover things for themselves they do not easily forget.

1.1.2 Primary school teachers' preparation

In Botswana pre-service for primary teacher preparation is offered at diploma and degree levels. Trainees may enrol in a three year diploma course at any of the three Colleges of Education which are Tlokweng, Francistown and Serowe colleges of education. At these colleges, trainees follow the same mathematics syllabus. During the first semester of their first year, student-teachers are treated as generalists. They are taught basics on the different primary school syllabus subjects (T. Sabone, personal communication, May 14, 2019).

Trainees may enrol in a degree program at the University of Botswana. In this program, trainees are given basics of teaching during their first year of training. The degree starts on the second year and it lasts for three years. Trainees from other disciplines with a minimum Bachelor's qualification may enrol in a one-year post graduate course at the university to obtain a teaching certificate (University of Botswana, 2018).

One syllabus objective in mathematics, requires generalist student-teachers to utilize play activities such as games and drill in mathematics teaching (National Mathematics panel for Colleges of Education, 2009). This means that during teacher preparation, student teachers are encouraged to use mathematics games when they are out in the field.

Specialization is then introduced in the second semester of their first year. Traineesspecialize in specific subject areas. The specializations include; mathematics/sciences, languages, social/sciences and practical subjects in which a student-teacher chooses one (Moremi, 2015). In this second semester, there is an objective that requires mathematics specialists to learn how to utilize traditional games, commercial games, as well as drill and other play activities. Student teachers use these games in their learning of mathematics in the colleges of education. They are given both theory and practical assignments on mathematical games. In theory, they name and describe games that can be used to teach any given topic. As for practical work, they are assigned to construct or model

mathematical games and explain the mathematical concepts that may be learnt from those games (T. Sabone, personal communication, May 14, 2019).

Student teachers are taught how to use games to teach school mathematics and basic concepts learnt from these games are mostly basic operations terms. During class-time they make individual and group presentations on games of their choice, demonstrating the application of such games in teaching mathematics (T. Sabone, personal communication, May 14, 2019).

Student teachers are also given the opportunity to do teaching practice in primary schools. At these schools, they observe lessons taught by class teachers during the first week and are later given the chance to teach lessons using methods of their own choice. During this time, student teachers are encouraged to use child-centred methods to teach the different subjects. They may therefore choose to use games to teach mathematics (T. Sabone, personal communication, May 14, 2019). It is through mathematical games that learners are able to learn mathematics concepts and language (National Mathematics panel for colleges of education, 2009). This indicates that primary school teachers are trained on game-enhanced learning with the hope that when they are placed in the field of work, they implement what they have learnt. In this study, the researcher is investigating teachers' views on the extent to which basic operations games are used by primary school teachers to enhance the acquisition of mathematical language.

Singapore is rated as one of the best countries that provide a high class pre-service for mathematics teachers (Chen & Mu, 2010). The state government (through the Ministry of Education- MOE) and the National Institute of Education (NIE) are the two bodiesresponsible for providing pre-service teacher training in the country. According to Chen and Mu, the MOE sends untrained mathematics teachers for training at NIE which offers three primary school teachers' programs. The programs offered are;a two or four year

Diploma in Education (Primary), Bachelor of Science (Education) and Post Graduate Degree (Primary). A teacher may obtain a two year diploma (O-level Diploma) or a four year diploma (A- Level Diploma). The duration for Post graduate Degree is one year. Chen and Munote that, even though the programs differ in duration, the program content is just the same.

During pre-service training, the trainees go for teaching practice where they observe lessons for two to three weeks and they are later expected to do the actual teaching to gain experience (Chen & Mu, 2010). This indicates that the lowest teacher qualification in Singapore is diploma and the highest is degree. The country has four levels at which mathematics teachers are trained; two diplomas, a Bachelor's degree and Post Graduate. This shows that mathematics pre-service programs in Singapore are organised such that trainees are separated according to qualification and level of knowledge which makes teaching very easy. As a teacher, the researcher has also observed that it is easier to teach a group of students of the same level than teaching a mixed ability group.

Jojo (2019) contends that pre-service teacher training in South Africa is done at university level. Trainees enrol in a four-year program of Bachelor of Education and they are bound to learn mathematics during their first two years. Other degree holders who have not done education and would like to join the teaching profession are expected to enrol in a one-year post graduate course in mathematics to obtain a teaching certificate (Jojo). This implies that all South African mathematics teachers who are employed on permanent positions are degree holders and they have been trained for at least four years at the university.

The pre-service training program in Botswana is almost like the Singaporean program where trainees may obtain diploma, degree or post graduate. Trainees in these two countries go for teaching practice for some weeks to gain experience.

According to Suzanne, Cox and Edwards (2018) teacher trainees in the USA are taught learner centred approaches. The trainees are taught inquiry methods where learners plan, decide, research and solve problems for themselves. Milner-Bolotin (2018) who studied 'Nurturing creativity in future mathematics teachers through embracing technology and failure' revealed that elementary pre-service teacher training in USA emphasizes the use of simulation games to enhance mathematics learning. This indicates that the USA pre-service program for primary school teachers advocates for game based approach to enhance mathematics learning.

1.1.3 In-service education for mathematics teachers in Botswana primary schools

The government of Botswana emphasizes the implementation of school-based in-service education programs to promote teachers' professional being. Each school is encouraged to have an annual staff development plan which is geared toward equipping teachers with the knowledge and skills of teaching. It is mainly through in-service training that teachers can be taught effective teaching strategies such as usage of games (Bose &Seetso, 2016). Educational theorists such as Piaget, Bruner and Vygotsky emphasize play in children's learning. This indicates that in-service programs should assist teachers with such play strategies which include games. This study advocates for the use of basic operations games in mathematics lessons. Nevertheless, this study does not imply that failure to use games is the prime reason for learners to be posting poor performance in mathematics. The study is only suggesting that one of the causes of low learner-performance in mathematics is non-usage of games in teaching.

Despite all the effort that are being made with regard to performance improvement in primary school teaching and learning, mathematics performance of learners is reported to be fluctuating (Botswana Examinations Council (BEC), (2012, 2013, 2017).This implies that strategies that are currently being used to raise performance may be contributing in learner

underperformance in mathematics. This calls for action by the school leadership to do regularneeds-assessment in their respective schools. Needs-assessment is used to identify the problems that the school encounters, some of which relate to the teaching and learning process (Woods, 2018). The school management is supposed to make the school plan. This plan is intended to inform the staff development plan on what should be done to promote teachers' professional development. Then the staff development plan will serve as a guide to the school master plan on how the teachers will be developed. It is then that these problems may be addressed through school-based workshops, meetings and conferences (Woods).The researcher learnt this planning process during pre-service training but she observed that in the five schools that she has taught in, the school management does not carry out planning processes effectively. Sometimes plans are made and not implemented. At times there is no planning at all. This implies that the school management members have knowledge but are reluctant to put it into practice. In this case the regional in-service education officers should intensify school supervision on planning and implantation of plans.

1.1.4 A reflection on games and the acquisition of the mathematical language

One aspect that is critical in learning mathematics is the acquisition and use of the correct language (Booker, Bond, Sparrow & Swan, 2014). Mathematical language according to Oginni and Owolabi (2013) combines a number of elements such as mathematical symbols, mathematical terms, formulae and units. It is through this combination that teacher and the learner communicate during mathematics lessons.This indicates that learnershave to learn numerous aspects which include mathematical symbols (such as basic operations) and mathematics vocabulary in order to express themselves.

Acquisition of the mathematics language refers to the process of learning mathematics such that learners are able to correctly use mathematical symbols, vocabulary and other components to convey the correct message (Cirillo, Bruna & Eisenmann, 2010). This means

that learners are said to have acquired mathematical language when they have learnt the mathematical words and their correct meanings as well as the correct application of mathematical operations.

In the mathematical operation of addition, learners have to know words like ‘plus’, ‘add’, and ‘sum’, while in subtraction, they have to know ‘minus’, ‘subtract’, ‘difference’, and so on. This indicates that if learners have not mastered these addition and subtraction concepts, they are likely to master the application of the operations, particularly when solving word problems. Multiplication vocabulary includes; ‘product’, ‘times’ and ‘multiplied by’. ‘Divide’, ‘quotient’ and ‘sharing’ are division concepts that should be understood by learners (Booker, et al, 2014). Multiplication and division concepts also need to be understood by the learners for them to master the application of such operations

According to Booker, et al. (2014) very little attention is given to the learners’ acquisition of the mathematical language in elementary schools. Teachers usually focus on the teaching of numbers and neglect the aspect of language. Kasule and Mapolelo (2005) who carried out a study in Botswana contend that if the medium of instruction is a second language to learners, it can hinder the acquisition of the correct mathematical knowledge. Teachers carelessly use mathematical concepts without much consideration of what they mean. Examples include the use of ‘weight’ and ‘mass’, ‘capacity’ and ‘volume’ interchangeably (Newell, 2017). Even in basic operations topic, the problem of misuse of language also prevails, for example; teachers often say, ‘work out these sums.’ referring to questions that require the application of different operations (not only addition) (The SchoolRun, 2019).

Muijs& Reynolds (2018) pointed out that the education systems across the world encourage primary schools to promote the acquisition of literacy, numeracy as well as basic operations. It is therefore important for learners in Botswana primary schools to acquire the

mathematical language to communicate these numbers and the actions done on them. The researcher believes that the mathematics syllabus for Botswana primary schools should emphasize the correct use of language in a way that would make every teacher see that it is compulsory to teach mathematics topics (including basic operations) and the mathematical language in it.

Reflecting on games in teaching, Zaslavsky (1973) contends that games have been a part of people's lives and also that there are unique games which were played by ancient people, which were relative to the time and circumstances within which they lived. The implication here is that games are some form of activity that people do more often in their lifetimes. They relate to peoples' way of life or the activities that they do on their day to day life. Spielvogel (2017) who investigated the effectiveness of games in learning also asserted that civilisation resulted in games and people enjoyed playing them. This indicates that games are a result of the developments that people introduce from time to time that match their interests and lifestyles. Some of these games are cultural whileothers are foreign. People enjoy playing all of them. Teachers can use these games to enhance the acquisition of the mathematical language during mathematics lessons.

According to Riccomini, Smith, Hughes and Fries (2015), games can be used to enhance learners' acquisition of mathematical language. Teachers can do so by revisiting the mathematical language taught through playing mathematical games. Learners are more likely have a longer time remembering the concepts taught through games (Riccomini, et. al.). Learners will remember what they have been taught because they enjoy playing games.

A well-designed education system must have a combination of the primitive mathematical terms and the new ones. The old mathematics which is basically founded on the culture of its people should be combined with the foreign or formal mathematics (Rosa & Orey, 2011). This means that the understanding of the culturally based mathematics would

form the basis for understanding the new concepts. Since this study advocates for the use of basic operations games to enhance the acquisition of the mathematical language, teachers can use both local and foreign games to teach mathematics.

Considering the cultural values and knowledge which are mathematics-related when teaching mathematics would enable teachers to take into account the notion of teaching from known to unknown. Teaching from known to unknown makes learners to understand new concepts better (Piaget, 1962). Garegae-Garekwe (1994) revealed that cultural games (which this study refers to as local games) have a lot of mathematics in them. Garegae-Garekwe also asserted that it is easier for learners to understand mathematics if it is taught through these games.This indicates that the notion of teaching from known to unknown can be applied by using local games to teach new mathematical language.

Moyer-Packenham, Salkind, Bolyard and Suh (2013) noted thatit is a norm that only lower classes (standard one to standard three) are often seen playing games and doing more practical work in and out of the classrooms. Lower classes in Botswana primary schools have a known history of a better performance (even in mathematics) than upper classes (Makwinja, 2017). The researcher has observed that it is very rare to find upper classes in Botswana primary schools being engaged in games or any form of practical activity. Most of the time, they are taught at abstract level. Upper primary school learners are denied the opportunity to learn the content at concrete level where real objects are used or where classrooms are turned into play areas.

1.2 Statement of the Problem

Masole, Gabalebatse, Guga, Pharithi and BEC (2016) revealed that globally, students encounter problems in mastering most mathematical concepts. Their findings were part of the Trends in Mathematics and Science Study (TIMSS).Consequently, this makes mathematics to

be the most failed subject not only in primary schools but also in the other levels of education across the world – Botswana is no exception. As countries of the world are rated by TIMMS in terms of the mathematics performance, Botswana is amongst the countries that appear at the bottom of therating list (Masole et al.). This indicates that Botswana learners are under performing in mathematics.

The problem that the researcher identified and has attempted to address in this study was that many students are posting poor performance in mathematics. The underperformance in TIMSS studies matches those in national assessment within the country. Non-usage of games may be one of the factors that lead to learners' underperformance in mathematics (BEC, 2012, 2017).Research studies carried out in Botswana indicate that mathematics games can enhance mathematics learning (Bose & Seetso, 2016; Ekonesi & Ekwueme, 2011; Machaba; 2013).

The current mathematics syllabus for Botswana primary schools calls for the use of learner-centred methods to improve mathematics performance (CD&E, 2005). Using basic operations games is just one of these learner centred methods.

Since basic operations are fundamental to all mathematics topics which are included in the primary school curriculum, it becomes apparent that for mathematics performance to improve learners must be helped to master basic operations. Learners who have mastered basic operations are likely to perform better in mathematics.This is why the researcher is advocating for the use of basic operations games in teaching mathematics. According toBose and Seetso (2016) and Dweck (2015) gamescanteach them the mathematical language.This implies that basic operations games may be used to help learners to acquire the language of mathematics.

Mudongo (1996) and Garegae-Garekwe (1994) who studied the teaching of mathematics in Botswana primary schools found out that upper class teachers complain of

syllabus congestion and as such they feel that practical activities are time-consuming. The studies revealed that this is the main reason why learners are denied the opportunity to learn through play or manipulation of objects. This means that most of the teachers in upper classes use teacher centred approaches because they believe that lessons taught through learner-centred methods are prolonged.

1.3 Motivation of the Study

Basic operations topic is a foundation to all mathematics topics (Wilson, 2009). The researcher has observed that all the mathematics topics in the Botswana primary school syllabus require the application of the basic operations. The operations referred to are addition, subtraction, multiplication and division. As such, if a learner has not mastered these basic operations, then he or she is most likely to fail all the mathematics topics (Kling & Bay-Williams, 2014).

Since 2010, learners' mathematics performance in PSLE has been fluctuating and the average percentage for the subject has never gone above seventy percent in these eight years (BEC). The researcher being a mathematics teacher has observed that Botswana primary schools are experiencing low performance in mathematics because learners have not mastered the application of the basic operations. This conclusive statement is also supported by the unpublished results-analysis reports for the Southern regional primary schools of Botswana. In all the end of term results analysis reports for 2014 and 2015, learners posted poor performance in most of the items that required them to apply basic operations. This is an indication that learners in Southern regional primary schools have not mastered the basic operations. (Southern regional panel, 2014, 2015).

Similarly, BEC reports revealed that mathematics performance in the years 2011, 2012, 2013 and 2014 was lower than in most subjects. In 2017 PSLE mathematics performance

declined by 0.46% while other subjects like Science, Social Studies and Setswana showed improvement (BEC, 2017).It is through this study that the researcher wanted to avail moreinformation onmathematics games and how theycould be applied in mathematics teaching to enhancelearners' development of the language.

1.4 Purpose of the Study

The purpose of this study was to find out whether basic operations games are used in primary schools to teach mathematics. The researcher wanted to find out teachers' perceptions on whether basic operations games arouse learners' interest as well as to explore the mathematical language learnt from these games. This study also focused on revealing examples of basic operations games that enhance learners' acquisition of the mathematical language.

1.5 Research Questions

To attain the purpose of this study, the researcher focused on the following research questions:

(1) What are the teachers' perceptions on usage of basic operations games in mathematics lessons in Mochudi area primary schools?

(2) What are the teachers' perceptions on the extent to which basic operations games arouse learners' interest in the mathematics lessons?

(3) What are the teachers' perceptions on the extent to which basic operations games enhance the learners' acquisition of mathematical language?

(4) Which basic operation- games may be used in primary school mathematics teaching to enhance the learners 'acquisition of the mathematical language?

1.6 Significance of the Study

This study is important due to a number of reasons. Some of the reasons are as follows:

It is providing the readers with information on mathematics games that are currently used in primary schools to enhance mathematical language. The study also contributes knowledge to the readers on other useful games that may be used in schools to promote mathematical language.

The study will add more information on the field of research in mathematics, especially in the area of structuring pre-service training programs for mathematics teachers.

The study will also benefit different people and institutions such as teachers, the Ministry of Basic Education(MOBE), policy makers and educators. Mathematics teachers will learn new useful games that enhance acquisition of mathematical language whileMOBE and private education institutions will utilize the information in this study to improve the teaching strategies that should be used in their schools.

The policy makers on the other hand may use the information contained in this study to amend or improve the education policies. This study serves as a point of reference to educators such as authors, researchers, theorists and all those whose mandate is to educate people because it avails information on usage of basic operations games in primary school mathematics to enhance the acquisition of the mathematical language.

1.7 Delimitation of the Study

Due to time constraints, this study could not cover a population of all primary schools in Botswana. It only sought data from fourteen primary schools in Mochudi. This could have been a more viable research if the sample consisted of schools from all the districts in Botswana.

1.8 Theoretical Framework

This section indicates the theoretical framework that served as the basis for undertaking this study. Theories that relate to games are indicated in this study. The section starts by reflecting on the old theories of play by Bruner, Piaget and Vygotsky. The researcher referred to theories of play with the view that games are a form of play. At the end the section touches on game-based learning and active participation which are becoming predominant paradigms in mathematics teaching (Lampen, 2015; Mosimege, 2017; Plass, Homer & Kinzer, 2015).

1.8.1 Piaget's theory of cognitive development

According to Piaget, there are four stages of cognitive development, namely sensori-motor, pre-operational, concrete operational and formal operational. Most primary school learners need manipulatives in order for them to learn new concepts. Concrete objects are real objects (Piaget, 1977; Plass, et al., 2015). Primary school learners should be given opportunities that enable them to manipulate real things that they are taught about. This will help them understand what they are taught (Furner & Worrell, 2017). Games are good examples of such manipulative opportunities. Mathematics games involve the use of playing objects such as boards and counters which are used in board games (Verenikina, Harris &Lysaght, 2003). Other objects are computers which are used to play computer games, ropes used for skipping, stones used in mhele, morabaraba and diketo (Garegae-Garekwe, 1994).

It is not always possible to bring real objects to class to aid teachers. According to Piaget, representations such as pictures, drawings and models may be used. Piaget believes that representations are in the semi-concrete stage (Verenikina, Harris &Lysaght). Examples of mathematical games that require the usage of representations are snakes and ladders games which have pictures of snakes and ladders, monopoly which uses modelled buildings to represent real structures, counters representing different modes of transport, cards representing high and low cost places. Monopoly also uses faked (counterfeit) money to represent real money.

In his view, Piaget (1977) contends that the manipulation of objects during play promotes children's cognitive development. When children are engaged in play-activities, their thinking and reasoning capacities develop. Piaget also argues that children learn by imitating others. This implies that the use of basic operations games should be emphasized so that learners imitate others and master the basic operations and the language associated with such operations.

Games of rules are in one of Piaget's stages of classification. This stage also emphasizes the use of play in children's learning. It is based on the fact that some forms of play are game activities and that players need to understand such games and their rules (Piaget, 1977; Verenikina, Harris &Lysaght, 2003). For learners to grasp concepts that are taught through games, they must understand how those games are played. They must also understand the rules for those games.

1.8.2 Vygotsky's theory of social development

In his theory of social development, Vygotsky argues that for a child to develop cognitively he or she has to interact with others. Consciousness and cognition are the results of socialisation (Vygotsky, 1978). According to Vygotsky, play makes children to perform beyond their own cognitive and thinking abilities. Children should be given more play opportunities so that they develop mentally and their reasoning power increases. This study advocates for the use of basic operations games as a form of play, so as to enable children to perform beyond their capabilities.

Play in which children act out the roles of real life characters help them to achieve a mental representation of social roles and the rules of society (Verenikina, Harris &Lysaght, 2003). This means that as children take up positions to represent people in real life, they learn those roles and their culture. Teaching children their own culture is vital. They should learn

each other's culture and be taught to tolerate one another. This study also advocates for the use of local games as a tool to enhance the acquisition of the mathematical language.

According to Vygotsky's socio-cultural theory, the objects that children use during play are a clear representation of their culture and society. As such play helps children to acquire knowledge of the tools and their cultural meanings (Piaget, 1977; Vygotsky, 1978). Every culture has tools which do not only enhance the learning of culture but also the concepts that are in the games. Games vary from one culture to another. In some instances, the same game may be played by different cultures, with each culture using its own name and tools (Stockenstroom, 2018).

There are some forms of play in which children act and they do not use any tools or objects. Acting without any tools, separates those objects from their meanings. This promotes the development of abstract ideas (Verenikina, Harris&Lysaght, 2003). When this happens, it shows that players are able to understand and portray meanings of aspects of play without the help of tools (Sarama&Clements, 2009).

1.8.3 Bruner's theory of discovery learning

Bruner contends that children should be given more opportunities for self-discovery. When children discover things for themselves, this promotes their problem solving skills (Verenikina, Harris &Lysaght, 2003). This indicates that children should be allowed to work on their own to find solutions to problems. It also implies that learners should dominate lessons while the teacher facilitates learning. This study views games as a self-discovery kind of teaching method. It therefore emphasizes self-discovery with particular reference to the usage of basic operations games in the teaching of mathematics.

1.8.4 Game-based learning and active participation in mathematics teaching

Game-based learning and active participation are both founded on the old theories of play which are discussed in the previous sections. Education systems worldwide emphasize the use of child-centred methods in the classrooms. These methods call for active

participation of learners (Klein, 2007; Mesa, 2010).Play and games engage learners actively in the lessons.

According to Tucker and Johnson (2017), mathematics researchers are beginning to focus on the use of games in the teaching of mathematics. Some researchers advocate for the use of electronic games (Bragg, 2012; Drigas& Pappas, 2015; McLaren, 2017; Sayan, 2015). Examples of electronic basic operations games that may be used in schools are; defeat the monster, puzzle pics, morabaraba and world cup math (IXL Learning, 2018). Other researchers believe that usage of cultural games in mathematics teaching should be emphasized (Garegae-Garekwe, 1994; Gerdes, 2007; Nabie, 2015; Zaslavsky, 1973). There are many other kinds of games that may be used in mathematics teaching. All of them can make learners active and bear desirable results if used well.

1.9 Definitions of Terms

The following words were used more often in this study, therefore the researcher found it worthy to define them with reference to the context in which they are used.

Game: An activity that involves a challenge against either a task or an opponent, which is governed by a definite set of rules (Read, 2016).

Mathematical game: A game whose purpose is to teach some mathematical concept (s) (Soanes& Stevenson, 2003).

Mathematical language: correct concepts, phrases and sentences that define mathematics and mathematical scenarios or objects (Thompson, 2009).

1.10Organization of the Study

The research essay consists of five chapters. Chapter one presents the background of the study which outlines the following sub-sections: Current mathematics syllabus used in Botswana primary schools; Primary school teacher preparation and development; In-service education for mathematics teachers in Botswana primary schools as well as Reflection on games and the acquisition of the mathematics language. The chapter also presents the Statement of the problem Motivation of the study, Purpose of the study, Research questions, Significance of the study, Delimitations of the study, Theoretical framework and Definition of terms.

Chapter two presents literature review. The chapter consists of the following sections: The concept of gaming in mathematics teaching; Examples of the basic operation games; The context of teaching mathematics through games; Techniques for effective acquisition of the mathematical language through the use of basic operations games; The benefits of games in the teaching of mathematics; A reflection on the Botswana primary school mathematics curriculum and the usage of games; Preparation and development of mathematics teacher in Botswana primary schools and Summary.

Chapter three outlines the methodology of the study. The chapter is made up of six main sections: Research design; Population of the study; Sampling and sampling procedures; Instrumentation; Data collection procedures and data analysis.

Chapter four comprises of data presentation, analysis and discussion of results. Chapter five presents summary, conclusions and recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

This chapter reviews literature on the extent to which games are used to enhance the acquisition of the mathematical language in the teaching of primary school mathematics, more focus is on basic operations games. The chapter covers the following areas: The concept of gaming in mathematics teaching, The examples of the basic operation games, The context of teaching mathematics through games, Techniques for effective acquisition of the mathematical language through the use of basic operations games, Techniques for effective acquisition of the mathematical language through the use of basic operations games, The benefits of games in the teaching of mathematics, A reflection on the Botswana primary school mathematics curriculum and the usage of games, Preparation and development of mathematics teacher in Botswana primary schools, and at the end the chapter provides a summary which briefly reviews how much research has been done on the usage of basic operations games in primary mathematics teaching and the areas that still need further research.

2.2 The Concept of Gaming in Mathematics Teaching

Since this study focuses on usage of games in mathematics teaching, it is important to discuss the concept of gaming. In this respect, this section looks into what a game is and the role it plays in assisting learners to grasp what is being taught, and by so doing the section reveals the relevance of gaming in mathematics teaching. Having a clearer understanding of the concept of gaming, one would also be able to differentiate games from non-gaming activities.

People may be having different ways of defining what a game is but all these definitions are centred on the idea that games are practical activities that have one or more opponents, a starting and a finishing point, rules and objectives (Northcote, 2016; Way, 2011).Northcote asserted that the rules of a mathematical game should be based on mathematics. Players must apply mathematical processes, ideas or skills to solve problems they encounter in the game.

According to Yasin and Ahmet (2003), a game is the most crucial work of a child. Games are the main activities that children spend their time doing. When they are engaged in games, they will understand better because they will be doing something they are used to. This indicates that if teachers use games to teach mathematics, they would not be introducing a new thing to learners. The teachers would be introducing something that learners are used to.

Bragg (2012) in a study focused on the effectiveness of mathematics games in Australian primary schools contends that mathematics games may be used as a pedagogical tool in mathematics teaching and the study also revealed that teachers should consider the relevancy of games to the concepts they teach. This indicates that games may be used as a strategy to enhance the learning of mathematics, especially if teachers choose suitable games.

Jorgensen,Grootenboer & Niesche (2013) revealed that discussions and dialogues that learners are engaged in during gaming assist them in constructing knowledge referred to as the mathematical language. These methods emphasize active participation of learners in mathematics because learning becomes effective (Mesa, 2010; Petress, 2006). That is, as learners play games, they interact with one another and this makes them to easily understand the concepts taught.

Verenikina, Harris and Lysaght (2003), asserted that players have different roles in games. Players may choose to imitate other people's playing styles if they happened to have seen them playing. The authors also note that, if playersare able to make their own decisions

and choices on how to play, then such players would be displaying some problem solving skills. This implies that when basic operations games are played, one of the expectations would be to apply the operations correctly in order to achieve the objectives and learners may achieve the objectives of the lesson by copying or learning from other learners. According to Ross (2004) it becomes apparent that the teachers' roles are to show learners how to play the game, to ensure that rules are followed as well as to provide the opportunities. Teachers should be there just to guide, give support and clarification to learners during gaming.

2.3 Examples of Basic Operations Games

There are varieties of mathematics games that teach basic operations. Some are single-player while others are multi-player games. There are also electronic or computer games while others are not computerised. Some are board games while others are not (Squire, 2005; Young-Loveridge, 2005). Some games require boards for them to be played while others do not. Booker (2006) pointed out that games can be classified into mathematical and non-mathematical games. This indicates that some games can be used to enhance the learning of mathematical concepts while some may be used for any other purposes besides the enhancement of mathematics learning. This study is focusing on mathematical games which teach basic operations. So this implies that the mathematics games may be utilised in the mathematics lessons at different times and circumstances to enhance the acquisition of the mathematical language and mathematics concepts that the teacher would like to teach. The mathematical games may be classified as foreign and local. A lot of studies have been done on foreign mathematical games. Only a few are on local games that are used in the teaching of mathematics.

2.3.1 Foreign-basic operations games

In Botswana there are a number of foreign games that could be used to teach basic operations. Examples include dice and counters games, pontoon, snakes and ladders, darts, and score-keeping games. This category of games includes computerised or electronic games (for example; computerized mathematics puzzles, quizzes, monopoly and maze).

Booker, et al. (2014) observed that some basic operations games teach all the four basic operations which are addition, subtraction, multiplication and division. Examples include;mathematical puzzles, riddles and quizzes (Booker, et al.). Other basic operations games teach two or three basic operations. On rare occasions, certain games may teach just one operation. This indicates that mathematics teachers in primary schools can utilize the same basic operations game to enhance learning of different operations.

Description of addition and subtraction games

Addition is the first operation that is introduced at lower primary school (standard one up to standard four) in Botswana (CD&E, 2005).Lower primary school learners are taught addition of whole numbers and they are also taught that adding means combining quantities resulting in a larger quantity. At upper primary (standard five to standard seven), learners tackle addition of whole numbers and decimals. Subtraction is introduced after addition. Learners are taught that subtraction means reducing or taking away. Learners are taught that when they subtract, quantities reduce (CD&E). This means that basic operations games are taught across standards in Botswana primary schools. It also implies that basic operations games can be used to enhance the learning of mathematics concepts.

Moyer-Packenham, et al. (2013) and Smith (2018) gave examples of basic operations games which include; dice and counters games. Examples of dice and counters games (from the researchers' experience) are monopoly, and snakes and ladders. These are board games in which players throw dice and move counters, following the rules set for each of those games.

In most of the games, there is a starting point where all counters are placed and a finishing point.Players take turns to throw the die and move the counter according to the number shown on the die. The player whose counter would be the first to reach the finishing point will be the winner (Smith,2018).

Basic operations games help to promote confidence levels of learners when dealing with numbers. Learners can also practice addition and subtraction by using dice (Knight, 2003). Counters are position holders; they indicate the players' positions after playing. This helps to avoid cheating or confusion of players' positions. This means that dice and countersgames can enhance the learning of addition and subtraction concepts and the application of these two operations. Kapperman and Sticken (2006) elaborated how dice may be used to teach addition and subtraction. Players have to agree on a number that they would be targeting for example, if they agree that 100 is the target then players just add their scores, the first player to reach 100 will be the winner. In subtraction, players subtract their scores from the agreed target and the first player to reach zero wins.

Pontoon is another type of game that teaches young learners of different ability levels how to add and subtract numbers up to 21. This game is played using the 52 playing cards. The aim of each player should be to receive cards that give a higher value than other players but not exceeding 21. If a player exceeds 21, they lose and if the21 is made up of an Ace and a card of value 10, this becomes a pontoon.

According to Schiro (2009), score-keeping games are games in which the score keepers add scores. Thegames can be used to teach addition and subtraction. An example of those games is bowling and it is also called cricket dice (Carr, 2011). Other examples are bingo and estimating answers (Carr). Bowling is played by two learners; a bowler and a batter. The two players throw two dice in turns. The bowler starts first. The aim of this game is to obtain a two from the two dice, followed by a score of three, then four, up to a score of twelve. The

player has to obtain these scores in order. On the other hand, a batter throws just one die to obtain the scores two up to twelve. A player who managed to achieve a score of twelve first wins. Players can play two or more innings to give each player the chances to play as bowler and also as a batter (Carr).

The researcher used the idea of additive bowling by Carr (2011) and was able to initiate a variation of bowling which teaches subtraction. Instead of adding the scores, players can subtract a smaller number shown on the two dice from a bigger one. In this case, the aim would be to obtain a score of zero first, followed by one, then two, three up to five. The first player to reach five will be the winner.

The complexity of these addition and subtraction games differs from one game to another. The subtraction bowling can be made a bit complex by playing six innings. In the first inning, one of the dice must show a 'one' as players strive to obtain scores one up to five. In the second inning, the die must be a 'two', third inning, a 'three' and so on.In this variation, for the first inning, the highest possible score is five. In the second inning, it is four and in innings three, four and five the highest score is three. The highest score is five in inning six.Each inning can be awarded points, for example, ten points. The first player to reach the highest overall score of the innings will be the winner.

Thompson (2003) asserted that mathematical language that is expected to be learnt whilst playing these games include concepts such as 'sum', 'plus', 'bringing together', 'altogether' and 'total' for addition; 'minus', 'difference', 'the remaining' and 'change' for subtraction. Learning mathematical symbols should be paired with learning mathematics vocabulary to enable learners to acquire a sound understanding of mathematics (Moyer-Packenham et al., 2013). It is quite apparent that every mathematics topic has its own vocabulary.This indicates that mathematics vocabulary and symbols form part of the mathematical language and they enable readers to interpret mathematical statements. It is

through a combination of these that a person is able to write or interpret what has been written.

Multiplication and division games

Newell (2017) noted that most games that teach multiplication, also teach division. Examples of such games are scrabble and darts. Scrabble and darts help learners to practice multiplying by 2 and 3. At the same time they teach learners that doubling means multiplying a number by 2 and tripling means multiplying by 3.

Scrabble have multiple variations such as a word building scrabble and a number scrabble. In a word-building scrabble game, players compete by building words from the letters that they have and they gain points by so doing. Scrabble may be modified to be more mathematical by requesting players to build only mathematical concepts. This implies that learners can build words like 'multiply', 'product' and 'times' to enhance the learning of the mathematical language on multiplication. In division, players can build vocabulary such as 'divide', 'quotient' and 'grouping.' Players may gain points for each and every word that has been built.

In darts a board with circles of different sizes and numbers is pinned on the wall. If a player throws a pin and it lands in the larger circle, then the player will gain points that are equivalent to the number opposite to that circle. If he hits the medium-sized circle, the points double and they triple if he hits the smallest circle. Doubling means multiplying a given number by two, while triple means multiplying the number by three(DartsPiks.com, 2014). This implies that darts teaches multiples of two and three. It also teaches learners multiplication concepts like doubling and tripling (DartsPiks.com). The darts board is shown in figure 1.

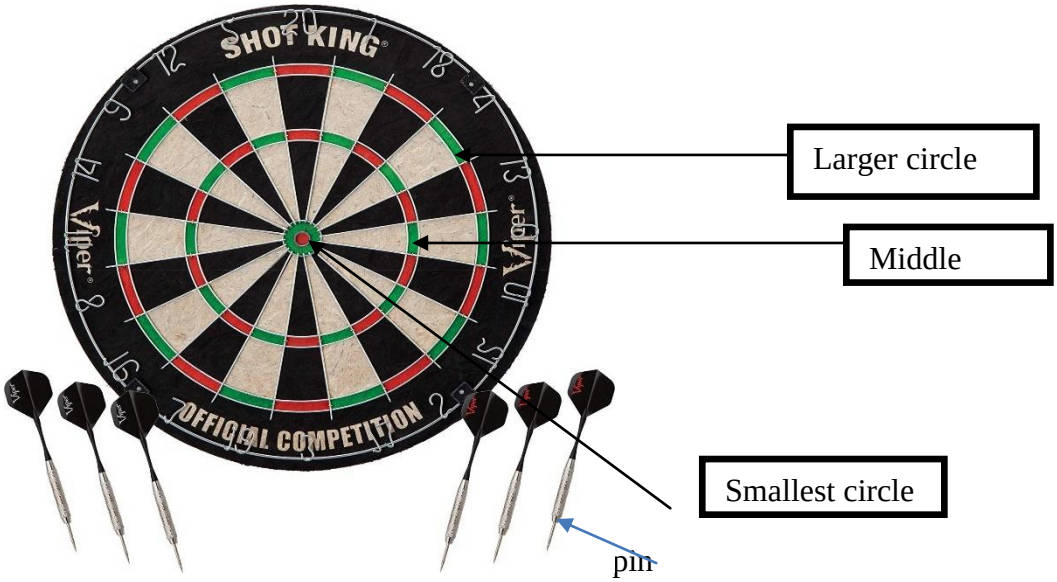

Figure 1 Darts board game. (Source: Leyva, 2019)

Information Communication Technology (ICT) is an important platform in the teaching of mathematics (International Mathematics Union [IMU], 2014). The platform offers games that may be used to teach multiplication. The examples include; mathematics puzzles, monopoly (Bartlett-Bragg, 2006), Guestimate (Bragg, 2012) and various video games (Swing &Anderson, 2008).These games may be used to reinforce the learning of multiplication concepts and ideas such as; multiples, finding the product of given numbers and understanding concepts like doubling, twice, tripling, quad, squaring, times, thrice, multiplied by and others. In monopoly, players are given the same amount of money, for example five hundred dollars,and each player is expected to buy stations and hotels as well as to pay bills and charges. When player A buys four houses at sixty dollars each, the player will be forced to work out how much he/she will pay. He/she can do repeated addition or say sixty times four.

Mathematics puzzles may also teach learners division concepts that include; quotient, sharing, divided by, grouping and classifying numbers. In division, when player B's counter lands at the position where the houses are placed, this player is charged a certain amount per

house, for example twenty-five dollars. The player may put the charge for each house separately (or making four groups of twenty-five dollars). This would signify that four groups of twenty fives equal one hundred.

2.3.2 Local basic operations games

Local games are those that originate within a certain society or group. These games are symbolized by the societal or cultural elements embedded in them. Nkopodi and Mosimege (2009) define local games as games that originate within a particular group and resemble the tradition of that same group. Rosa and Orey (2011) link cultural mathematics to ethno-mathematics by indicating that ethno-mathematics emphasizes the consideration of life characteristics and interests of cultures in the teaching of mathematics. In this regard, cultural games referred to by this study are those which relate to the traditions and beliefs of Batswana.

Ethno-mathematicians such as Gerdes (1994) and Zaslavsky (1973) advocate for ethno-mathematics or precisely, the use of cultural games in the teaching of mathematical concepts. This means that teachers should study local games which portray the culture of the children they teach and use such games to teach mathematics. The use of cultural games also supports the idea of teaching from known to unknown. This is because learners already know the cultural games from home so what the teacher would be doing is to help them understand the mathematics in the games. The researcher has also observed that when learners are taught from known to unknown, they grasp the concepts quickly.

Garegae-Garekwe's (1994) study was designed to find out if primary school teachers incorporate cultural games in mathematics teaching. She noted that, games such as skipping rope, and hide and seek have a lot of counting in them and they also teach addition, subtraction and multiples while France-skipping teaches all the operations.

The researcher has experienced that, in some games like chaka-chaka, songs are sung or verses recited while playing the games. In chaka-chaka for example, players recite multiples of numbers from one upwards. The songs and verses in cultural games have a lot of mathematical concepts which can lay a very good foundation if utilised in the mathematics lessons. The implication is that cultural games may be used to teach mathematics because they have a lot of mathematical concepts.

Garegae-Garekwe (1994) and Mudongo (1996) pointed out a number of games that are of Botswana origin and culture. These two studies mentioned games such as dibeke, koi, mhele, diketo and khupele-khupele. These games have a lot of mathematics in them (Garegae-Garekwe). For example, in dibeke learners count in 2s and this teach them multiples of 2 while diketo can teach all multiples. The researcher applied her experience on the games and demonstrated how these games can teach addition and subtraction. During mhele and khupele-khupele, players can promote their addition and subtraction knowledge by recording the counterparts' counters that have been removed from play. Addition can be learnt as players add on points (or counters) removed and in subtraction, players can subtract the number of removed counters from the total that each player started with.

Mudongo (1996) observed that dibeke and diketo also help learners to count in1s, 2s, 3s, 4s and so on. In diketo, which Knight (2003) calls tossing and catching stones, a pattern of small holes are dug and players' aim is to put a required number of stones inside these holes and any player who fails to do so is out. This teaches addition, multiplication and subtraction (Knight). According to the researcher's own experience, at times players start the diketo game by putting stones into the holes and then the gist of the game becomes the part where they remove them. They start by taking stones out in 1s, then 2s, 3s and so on. As they do that, they learn subtraction and division. In the dibeke game, a large square of about 30 by 30 metres is drawn on the bare-flat ground. Four big circles are then drawn at the corners of

this square. One team of players should be on the field, just like softball, to catch the ball. As for the other team, one player would be called by name to come and kick the ball. Players in this team are required to run into the four circles and counting at the same time. These circles act like bases. More focus of this game is to teach counting as well as the multiples of four. Players are required to ensure that as they go around counting, they should have the multiples of four at the starting base.

This study aimed at finding out whether primary school teachers use basic operations games to enhance the learning of mathematics. The study focused on the use of both foreign and local games while Garegae-Garekwe (1994)'s study focused only on the use of cultural games in mathematics teaching. This study therefore advocates for usage of all kinds of basic operations games as an instructional tool to teach mathematics. This is because local and foreign basic operations games have basic operations concepts. When learners play thesegames, they may acquire the mathematical language.

2.4 The Context of Teaching Mathematics through Games

Since this study is investigating the extent to which basic operations games are used by primary school teachers to enhance the acquisition of the mathematical language, this section is focusing more on how these games are incorporated in primary school mathematics teaching. However, it must be noted that much of the available literature reveals the usage of games in mathematics teaching in general, not necessarily the usage of basic operations games only. Some of this literature is on usage of games in the teaching of mathematics in other levels of education such as pre-schools, secondary and tertiary. Only a few focuses on usage of basic operations games in the teaching of primary school mathematics. Very few research studies were found on usage of basic operations games to enhance the acquisition of the mathematics language in Botswana primary schools.

Bose and Seetso (2016) in a study on teaching science and mathematics in Botswana pre-schools concluded that, "teachers did not know that mathematics and science concepts were embedded in local games and could be taught simply by playing them" (p. 6). This indicated that teachers lack pedagogical knowledge of teaching science and mathematics. As a result, Bose and Seetso developed a resource book of games and rhymes to boost pre-school teachers' pedagogical knowledge. By so doing, their study was advocating for the use of local games in the teaching of science and mathematics.

Studies by Salani and Maphane (2014), and Bose and Seetso (2016) indicate that mathematics should be taught through child-centred methods. Teaching through games is just one example of such methods. This means that teachers should afford learners to do most of the learning activities in mathematics lessons.

A Study by Major and Mangope (2012) which focused on the constructivist theory of mathematics learning in Botswana primary schools revealed that teachers prefer to use more traditional teaching methods. Such traditional methods include lecturing, teaching problems just the way they appear in textbooks and rote memorisation instead of using child-centred methods such as games.

Vinson (2001) revealed three main reasons why teachers use teacher-centred methods in mathematics lessons. One of the reasons is that teachers spend more time sitting down instead of moving around the class. The other is that teachers give the same work to all learners. The third reason is that teachers focus only on whole class instruction. This indicates that teachers prefer to use strategies in which they do not fully engage learners in the mathematics lessons. Teachers prefer methods that do not exhaust their energy such as giving instruction to whole class as opposed to group work. Even in Botswana, teachers do not often use learner centred methods. Ekonesi and Ekwueme (2011) and Machaba (2013) revealed the effectiveness of games in mathematics teaching in Botswana but teachers still do not incorporate games into

their day to day teaching of mathematics. The current mathematics primary school syllabus calls for the use of learner centred methods in teaching. In mathematics, the syllabus emphasizes the use of games in some topics. It is therefore important for primary school mathematics teachers to enhance the acquisition of the mathematical language through games.

According to Bose and Seetso (2016), and Salani and Maphane (2014), primary school children learn better when learner centred methods are used. The implication is that when teachers use teacher centred methods, learners are likely not to understand the mathematics taught. This study encourages teachers to use basic operations games as a way of enhancing the learning of the mathematical language.

Kapperman and Sticken (2006) in their study on Project Math Access found that, before learners can apply the four basic operations, they must have acquired the basic concepts such as ‘more’, ‘less’, ‘many’ as well as basic numeracy. It is important for learners to know certain mathematical ideas as basics before they can be taught the basic operations. According to the authors, ‘roll a die’ game is one good example that may be used to teach basic concepts as well as the basic operations themselves. Teachers may use ‘roll a die’ game to assist learners in acquiring the important mathematical language that paves way for the learning of basic operations. It also means that the game may be used to teach basic operations themselves. As players add and subtract the throws they made from the die, they learn the operations, especially addition and subtraction. A good example is when they play snakes and ladders (Hurley & Turner, 2004).

2.5 Techniques for Effective Acquisition of Mathematical Language through Games

A study by Bold (2001) revealed that mathematics teachers are not always precise on mathematical language. Bold also indicated that the use of pictorial images and gestures can

effectively enhance the understanding of meanings of the mathematics vocabulary. Some basic operations games use pictures while others use gestures which clearly shows that the games may be used to effectively teach mathematical language

Structure of the games has to be taken into consideration so as they address the purposes for which they were applied (Schmidt, Emmerich & Schmidt, 2015). Teachers should make good choices of the games, depending on what they want to teach. There are hints that are more or less like techniques which explain how games should be administered. Some of them cannot be applied alone, so teachers can make combinations where necessary. Booker (2006) suggested the following hints which are also teachers' roles; focus on outcomes rather than technique; make learners experience and dominate; respect learners' differences in their thinking abilities; highlight key points; motivate learners all the time and provide challenging situations.

The hints above encourage the use of child-centred strategies where learners take control of the lessons and teacher just becomes the facilitator. Learners are to be recognised in whatever they do or say and they are supposed to be given maximal participation. The hints also indicate that when playing the game, the results are the ones that matter rather than the method applied. It is quite clear that all games need to be structured somehow, including games that teach basic operations.

2.6 The Benefits of Games in the Teaching of Mathematics

Research has revealed reasons why games should be used in the teaching of mathematics. However, it is important to note that games are different in many aspects which means even their benefits differ. Teachers have to know why they want to engage their learners in gaming. Again, games may be classified in many different ways. The classes of games that this study considered are those which are mainly describing the benefits for the

games. Bragg (2003) whose study was to investigate the effectiveness of games in leading learners to concept formation classified games into the following classes; games for drill and practice, games for concept reinforcement, games which lead to concept formation and games for fun. Basic operations games fall into most of these classes. However, this study focusedon basic operations games as a method that enhances the acquisition of the mathematical language. This implies that in this section, the study considers basic operations games as games which lead to concept formation and concept reinforcement.

Games can help learners to understand mathematical statements, expressions and any mathematical communication (Trawick-Smith, Swaminathan, & Liu, 2016). This indicates that games can enhance the acquisition of the mathematical language because as they play games they communicate with each other and they may repeatedly use some mathematical statements and expressions.

According to Nisbet and Williams (2009), some games may be used to help learners memorise concepts, others may teach and help them to master the concepts taught while certain games are just played for enjoyment. Bose and Seetso (2016) contend that games are a source of enjoyment in learners.Games also help to improve students' attitudes toward mathematics.

Mathematics games promote valuable skills in learners such as thinking comprehensively, planning, communication and negotiation skills, application of numbers and operations, group decision-making and data-handling (Wiersum, 2012). In addition to these skills, applying the basic operations to solve problems skills can also be acquired through playing basic operations games. These skills enable the learner to understand mathematics as well as to use it to solve day to day problems. Teachers must help students to see mathematics as a problem-solving tool not only in classrooms activities, but also in real lifesituations.

2.7 Botswana Primary School Mathematics Curriculum and Basic Operations Games

The current mathematics curriculum for Botswana primary schools is characterised by teacher-involvement in its making and it also advocates for learner-centred mathematics lessons, which are mainly group work and discussions (CD&E, 2005; Makwinja, 2017). Group work and discussions are also a form of cooperative learning, emphasized by Vygotsky in his theory of cooperative learning which is founded on the notion that; 'What children can do together today, they can do alone tomorrow' (Mosothwane, 2014). Teachers are encouraged to put learners into groups and have them discuss concepts taught. Since games are child-centred and are also a form of cooperative learning, this study encourages teachers to use games to teach mathematics. The current curriculum stipulates that teachers are expected to use child-centred methods as they teach syllabus objectives and also to relate mathematical lessons to real life.

Attainment targets of the problem solving modules in the syllabuses suggest usage of games as a way of promoting child-centred lessons. The problem solving module in both lower and upper syllabuses introduces learners to mathematics games and puzzles. There are specific objectives in these modules that expect teachers to use games in mathematics teaching. Examples of such objectives in lower primary syllabus are; 4.1.1.1- play games and 4.1.1.2 - solve puzzles. Another objective in lower primary syllabus which reads, 'play simple number games involving addition and subtraction,' indicates that games can be used to teach basic operations. In upper primary syllabus, the objectives are; 4.1.1.1 - play mathematical games, 4.1.1.2 – solve mathematical puzzles. In statistics, the objective 5.4.1.2 expects standard seven learners to use probability games and identify all possible outcomes (CD&E, 2005). This indicates that the current primary school mathematics syllabus advocate for usage of games in some topics.

It is necessary to use basic operations games to teach all the mathematical lessons. This would be the best method because the game will not only be teaching basic operations but also the mathematics concepts. Teachers just have to make a choice of the games, depending on the new concepts they would be introducing or enhancing the ones that have already been taught.

According to CD&E (2005), teaching mathematics through child-centred methods promotes learners' communication skills. The method enables learners to develop cognitively and it also strengthens their mental power. As learners become fully engaged in mathematical activities, they would discuss, experience and learn on their own. This will enable them to think logically and make informed decisions (CD&E). Even though the current mathematics curriculum emphasizes the use of learner centred approaches, there is very little emphasis on the use of games. Nothing has been mentioned on basic operations games. This calls for curriculum review so that the new curriculum would include objectives on basic operations games in most of the topics.

Marklund and Alklind (2016) argue that teachers' roles have to be emphasized if games are to be included in the school curriculum as a teaching strategy. Teachers should also be active members in the lesson as they are expected to facilitate the lesson fully by providing opportunities, materials and any assistance that learners need. This means that both the learner and the teacher should be fully engaged in a lesson. In contrast, the expectations with respect to Botswana primary school mathematics curriculum are that the learner shoulddominate the lesson while the teacher facilitates (CD &E, 2005).

2.8 Preparation and Development of Botswana Primary Schools Mathematics Teachers

Teacher preparation and development in this study is focusing on teacher-training on the usage of games in the teaching of mathematics. This training is looked into under the two sub-headings which are pre-service training and in-service training.

2.8.1 Pre-service teacher training and usage of games

Pre-service teacher training is a program of a certain degree which is designed to prepare people to become teachers in the future (Erdem, Kocyigit & Atar, 2019). This means that this form of training is provided to people before they become teachers. In Botswana pre-service training of primary school teachers is done at three Colleges of Education namely; Tlokweng, Serowe and Francistown Colleges of Education, and at the University of Botswana.

During pre-service training, trainees are taught numerous teaching methods which include usage of games in mathematics learning.Bolden, Harries and Newton (2010) alluded that games are important instructional tools because they provide opportunities for learners to have fun in the mathematics lessons. Basic operations games are amongst these fun opportunities. Pre-service programs should therefore be designed in a way that familiarizes teachers with gaming methods (Bolden, Harries & Newton).

Meletiou-Mavrotheris and Prodromou (2016) in a study, 'Pre-service teacher training on game-enhanced mathematics teaching and learning,' reveal that mathematics teachers who received pre-service training on gaming show competence in the application of the method. Shah (2015) also indicates that offering game-based learning during pre-service teacher-training equips teachers with the roles they should play during a gaming lesson as well as the knowledge of how relevant games may be selected. The results of the study by Shah also indicated that there is a strong correlation between games and learners' conceptualisation of mathematics. This means that games are very good at enhancing learners' acquisition of the mathematical language.

The researcher trained as a primary school teacher and she experienced that in the College, teacher-trainees were taught that primary school children should be taught through child-centred methods. The National Mathematics panel for Colleges of Education (2009), which is the mathematics curriculum for the colleges of education in Botswana, emphasizes the use of games and drill to teach mathematics. The trainees learn theory and are expected to put it into practice by making projects (National Mathematics panel for Colleges of Education, 2009). This implies that teachers are trained on the use of mathematical games during pre-service training. However, there is no mention of basic operation games in the curriculum. They are just taught about usage of mathematics games in general.

This study promotes usage of basic operations games in mathematics teaching by providing information that would assist in improving the pre-service training of primary school mathematics teachers on basic operations games.

2.8.2 In-service training for primary school mathematics teachers

The researcher noted that there is minimal local literature on in-service training in primary school mathematics. The University of Botswana offers in-service teacher education program at degree level.Teachers enter the program at different levels depending on their professional qualifications and work experience. Teachers who possess teachers' certificates enrol in a four year degree program and those with a two year diplomatake three years to complete the program.Trainees who possess a three year diploma and some work experience are admitted in the third year of the program and their duration is two years (University of Botswana, 2018). There is no research that reveals whether any of the in-service programs addressed the ideas of game-based teaching and learning in mathematics.

Ifamuyiwa and Akinsola (2008) suggest that mathematics teachers should be trained to use self and cooperative strategies, since these strategies are more effective in developing positive attitude of learners toward mathematics. In-service training sessions should equip

teachers with strategies that enable learners to work in pairs or groups. When using such strategies during mathematics teaching, it will be easy for learners to grasp the mathematical ideas (Ifamuyiwa & Akinsola).

In-service teacher education, training reforms such as the National Charter in Education recommends for further studies of mathematics teachers to improve their quality (IMU, 2014). This is in line with the recommendationby IMU that in-service teacher training and support program should help countries to produce more focused learners. These are learners who could solve problems by themselves and such learners would be those who acquired the skills such as the mathematical operations.

In-service teacher training programs can be offered through short term workshops on teaching methods (Makwinja, 2017). These workshops can be organised by individual schools, clusters or the regional education offices. Teachers can also be sent for further studies to equip them with more teaching methods that would make them better mathematics teachers. An example of the teaching methods that teachers should be equipped with is the use of basic operations games to enhance the learning of the mathematical language. The teacher training colleges in Botswana should emphasize the use of basic operations games in primary school mathematics teaching. By so doing the teachers would be able to produce learners with relevant knowledge and skills. This study is also emphasizing the use of basic operations games in primary schools to enhance the acquisition of the mathematics language.

2.9 Summary

Primary school learners in Botswana are continuing to post poor performance in mathematics. It is not clear as to what the causes of this poor performance are (BEC, 2012; 2013; 2017). Some studies link this low learner performance to teachers' inability to interpret syllabus objectives which may lead to inability to deliver the right content to the learners

(Levenberg & Patkin, 2014). Others studies link this performance to poor teacher quality and therefore advocate for well-organised pre-service and in-service training programs (Mapolelo & Akinsola, 2015).

Some educational studies therefore advocate for the use of child-centred approaches in mathematics teaching (Bose & Seetso, 2016; Salani & Maphane, 2014).The Mathematics curriculum for primary schools also advocate for usage of group work and discussions which are learner centred. Other studies such as Ifamuyiwa and Akinsola (2008) and Mosothwane (2014) emphasize the use of cooperative strategies. These are teaching methods in which learners dominate the lessons as they are given the opportunity to discover solutions for themselves. This study follows the same sentiments as it advocates for the usage of basic operations games to teach primary school mathematics

Research studies advocate for the use of games in mathematics teaching (Meletiou-Mavrotheris & Prodromou, 2016; Shah, 2015) because they have been found to enhance the learning of mathematics. The studies also revealed that games differ in terms of structure as well as with the purposes or reasons for which they are applied. It is therefore upon the teacher to choose the game, structure and facilitate it. Most importantly, teachers are encouraged to use basic operations games when teaching basic operations or any topic relating to these operations these games enhance the acquisition of the mathematical language.

Foreign and local basic operations games were revealed by research. Some of these games may be used to teach mathematical concepts such as counting, multiples of some numbers, adding, subtracting, dividing and multiplying. Others may be used in the mathematics lessons with the aim of arousing learner interest in the subject. However, some studies have revealed that primary school teachers rarely use games in mathematics

lessons(Bose & Seetso, 2016; Machaba, 2013). In most cases, teachers do not use games when they teach mathematics.

During pre-service education, teacher trainees are taught how to use learner centred approaches in mathematics teaching in primary schools. The trainees are also taught to use games and drill in mathematics teaching and this objective is emphasized in the college syllabus. Specific names of games are not mentioned in the syllabus. It is therefore very important for teacher education institutions in Botswana to review their syllabus and ensure game enhanced learning is promoted, especially using basic operations to teach mathematics.

There is very little literature on in-service training of mathematics teachers. Teachers in the field also need to be equipped with the knowledge of teaching methods especially those that make learners to work in groups or pairs. This study emphasizes the use of basic operations games in mathematics teaching. This impliesthat more research should be done on in-service training of primary school teachers on usage of basic operations games in mathematics teaching.

CHAPTER THREE
METHODOLOGY

3.1 Introduction

This chapter presents the methodology of the study that investigates Botswana primary school teachers' views on the extent to which basic operations games may be used to enhance the learners' acquisition of the mathematical language. The study was to find out whether primary school teachers in Botswana use basic operations games in the teaching of mathematics or not. It also availedinformation on the usefulness of basic operations games in enabling learners to acquire mathematical language as well as to arouse their interest in the mathematics lessons. The study collected data from Mochudi primary school teachers and Heads of Departments (HODs) through the use of questionnaires and interviews.

The chapter covers the following eight sections: Research design; Population of the study; Sampling and sampling procedures; Instrumentation; Validity of the instruments; Reliability of the instruments; Data collection procedures; Data analysis and Ethical Considerations.

3.2 Research Design

The study engaged a mixed method research design which combined quantitative and qualitative approaches. Mixed approaches were used more often by researchers for purposes of triangulation. Clark (2010) utilized this approach in the study; 'The adoption and practice of mixed methods: US trends in federally funded health-related research' and the results revealed that the mixed approach converges data successfully. Many researchers use mixed methods designs nowadays. Examples include Yong, Gates and Chan (2019), Kaloo, Raggernauth, Ramsawak-Jodha, Sabeerah, Abdul-Majied, Dedovets, and Barrow (2019) who integratedqualitative and quantitative methods to investigate the impact of games in the

learning of mathematics. Yong, et. al's study investigated the impact of computer games in the acquisition of metacognitive skills while Kaloo, et. al used mixed methods to explore tensions, challenges and possibilities in mathematics and science classrooms when game based approaches are used.

The quantitative approach was employed through questionnaires designed to collect data on teachers' perceptions on usage and impact of basic operations games in mathematics' learning. Similarly the qualitative approach was employed through the questionnaires to yield data on teachers'perceptions on the usage and impact of basic operations gamesinmathematics' learning. Qualitative data was also collected through interviews of HODs from the selected schools. This helped to collect data of teachers' perceptions on the impact of basic operations games in mathematics' learning.

3.3 Population and Sampleof the Study

The population of this study consisted of all teachers and HODs in the fourteen Mochudi primary schools. The primary schools in Mochudi have a total of two hundred and eighty (280) teachers and forty-nine (49) HODs.A sample of the study consisted of seventy (70) teachers and fourteen (14) HODs from the fourteen schools. At each school, five (5) teachers and one (1) HOD were randomly selected. This indicates that twenty five percent (25%) of teachers and twenty nine percent (29%) of HODs were used as the sample for this study. Johnson and Bhattacharyya (2001) indicate that sampling process should be impartial, that is, ensuring that all elements of the sample are given equal opportunities. This means that fairness must prevail so as to avoid biasness in the selection of the subjects.

A list of all teachers in each school was provided. It is this list that the researcher referred to in order to write down all the names of teachers on pieces of papers. At each school, teachers' names were folded and put in one box. A learner was asked to shake the box

and then picked out five (5) names from the box without looking. The five teachers selected from each school formed the sample. This made up a total of seventy (70) selected teachers. Similarly, names of HODs at each of the fourteen schools were written in the separate pieces of papers which were folded and put in one box. One piece was picked out by a learner without looking. The HOD picked formed part of the sample. In total, fourteen (14) HODs were selected.

3.4 Instrumentation

Two data collecting instruments, interviews and questionnaires were used in this study. Data collecting tools such as interviews and questionnaires should be well designed such that they appropriately collect data that they were intended to collect (Cardiff University, 2006).

The researcher used interviews because they are known to collect detailed information about personal feelings, perceptions and opinions (Cardiff University, 2006). Interviews allowed both the researcher and the subjects to seek clarification during administering. In addition, interviews provide well elaborated data (Susuwele - Banda, 2005). Data collected through teacher questionnaire was intended to triangulate the information collected by interviewing HODs. Triangulation was done in this study so as to yield a more trusted outcome (Zohrabi, 2013).

Questionnaires are known for collecting a lot of data within a short period of time and they can also be used to study many attributes such as different behaviours, values, beliefs and attitude (Menter, Elliot, Hulme, Lewin & Lowden, 2011). This means that a questionnaire can ask questions on different aspects and it can also be answered by a large number of subjects in a short period.

3.4.1 Designing of the interview guide for heads of departments

The interview guide was designed for HODs (Appendix A). It consists of six structured questions. The researcher used most of the questions from Hang (2017) but modified them to suit this study. Hang's study focused on usage of English Language games in the teaching of English. The modifications were done on Hang's interview guide so that the guide focuses on the following key areas from the research questions; usage of basic operations games in mathematics lessons, learners' arousal of interest by basic operations games, enhancement of the acquisition of the mathematical language by basic operations games and examples of basic operations games.

The items in the interview schedule were divided into foursections namely; Section A, B, C and D. Each of these sections focused on one of the research question as illustrated in Table 1.

Table 1

Structure of the interview schedule for HODs

Sections of the interview schedule	Research question targeted
A: Teachers' perceptions on whether basic operations games are used in their schools	1
B: Teachers' perceptions on whether learners' interest can be aroused by basic operations games	2
C: Teachers' perceptions on whether basic operations games can enhance learners' acquisition of the mathematical language	3
D: Examples of basic operations games and the basic operation they promote	4

Section A collected data of HODs' perceptions on usage of basic operations games in their schools. Data collected in this section assisted the researcher in answering the first research question: What are the teachers' perceptions on usage of basic operations games in mathematics lessons in Mochudi area primary schools?

Section B sought data on HODs' perceptions on whether learner-interest can be aroused by basic operations games. This data assisted the researcher to answer the following research question 2: What are the teachers' perceptions on the extent to which basic operation games arouse learners' interest in the mathematics lessons?

Section C sought data on HODs' perceptions on whether basic operations games can help learners to acquire the mathematical language.This data assisted in answering research question 3: What are the teachers' perceptions on the extent to which basic operations games enhance the learners' acquisition of mathematical language?

Section D of the interview schedule had one question which sought data on basic operations games and the basic operation they promote. The basic operations referred to here are; addition, subtraction, multiplication and division. Data collected in this section assisted the researcher in answering research question 4: Which basic operations games may be used in primary school mathematics teaching to enhance the learners 'acquisition of the mathematical language?

3.4.2 Designing of the teacher questionnaire

The teacher questionnaire (appendix B)was designed to collect data from seventy (70) participants. The researcher similarly relied on the questionnaire used by Hang (2017). This questionnaire was modified by re-phrasing items to suit the study. Items which did not address any of the research questions for this study were left out.

The designed questionnaire had three sections: Section one consisted of six statements in which respondents were to tick either a 'YES' or a 'NO' to indicate agreement or disagreement; Section 2 had eight statements where a five point Likert scale was used to seek respondents' levels of agreement. Section 3 had five open-ended questions which required respondents to express themselves fully on the spaces provided. The questionnaire had nineteen (19) questions altogether.

Each of these three sections had items addressing the four themes which were derived from the research questions of this study. The themes were; usage of basic operations games in mathematics lessons, teachers' perceptions on learners' arousal of interest by basic operations games, teachers' perceptions on the enhancement of the acquisition of the mathematical language by basic operations games and the examples of basic operations games that enhance the acquisition of the mathematical language.

3.5 Validation of Instruments

Johnson and Bhattacharyya (2001) encourage the pre-testing of the instruments for reliability and validity purposes. This is because pre-tested instruments accurately measure what they are intended to measure and they are more likely to produce the intended results (Doherty, Ramsey, Ibbotson, Carcary & Conway, 2018). The implication here is that following pre-testing, ambiguous questions are removed or corrected. Appropriateness of questions to the problem of study and the research questions is also ensured.

Adopting instruments that have been tested and used in other studies is advantageous because most of these instruments have been tested several times and corrected to do away with factors that may affect their validity and reliability. Such instruments are likely to have a high internal and external validity (Jonson and Bhattacharyya (2001).

The researcher re-validated the instruments because of the modifications made. For example, items in the two instruments were re-phrased to address basic operations games as opposed to English Language studied by Hang (2017). A few questions which did not suit this study were also left out.

A month before the pilot study, the researcher requested two University of Botswana-lecturers who are mathematics specialists to critique the instruments for their relevance to the problem of study. The researcher ensured that the specialists engaged are knowledgeable in the area of mathematical games (including basic- operations games) and mathematical language. A specialist in languages was also consulted to test the readability of the instruments. This helped the researcher to do away with ambiguous and meaningless questions and phrases. It took the three specialists almost a month to complete their assigned tasks. At last they reported that the instruments were readable and relevant to the study.

3.6 Reliability of Instruments

According to Lodico, Spaulding and Voegtle (2010), reliability deals with how consistent the results obtained from an instrument are. These results may be obtained at certain intervals from the same individual (or group). This indicates that a reliable instrument is one that yields the same results if used more than once.

Triangulation derived from the use of two instruments can lead to a more dependable data and boosts reliability of the instruments (Zohrabi, 2013). This means that a more reliable data is likely to be obtained if two or more instruments are used together. This study used the mixed approach so that it provides a more comprehensive and understanding of the research problem.

A pilot study was carried out at one school in Lobatse two weeks after validity-check. The sample for this pilot study consisted of twenty teachers and two heads of department.

The idea of using lists of teachers, as well as the lists of heads of departments was applied in selecting the sample. Teachers' names were selected at random from the box and the same procedure was followed when selecting the heads of department. This selection of subjects was done in a day.

Prior to collecting data, terms used in the interview guide were explained to ensure that the subjects understood the questions. More clarity was also made during the interviews when the researcher felt that the subjects might have not understood the items. This improved reliability and internal consistency of the interview guide (Tavakol & Dennick, 2011).

Data of the pilot study which was collected through the eight items of the Likert scale in the questionnaire was analysed using SPSS. In this analysis, a Cronbach's alpha determined an alpha value of 0.71when all the eight items were included and 0.833 when one item was deleted (See appendix C).However, the researcher did not delete the item because the alpha value of 0.71 is still within the acceptable range when the item is included. The alpha value of 0.71 showed that the questionnaire is reliable and has an acceptable internal consistency.An instrument is considered to be having an acceptable internal consistency if its alpha value is within the range of 0.70 and 0.90 (Tavakol & Dennick, 2011).

3.7 Data Collection Procedures

This section presents how data for the study was collected. The section starts by presenting preliminary arrangements for data collection. One month before collecting data, the researcher asked for permission from Kgatleng regional education office to carry out a study in fourteen Mochudi primary schools (see appendix D). The researcher took only one day to drop a letter at the regional office which was requesting for permission to undertake a study in Mochudi schools, permission was granted (appendix E). In the following week, the researcher took one week to drop letters which were requesting school heads to permit her to

undertake a study in their respective schools (see appendix F).Copies of a permission letter from the regional office were attached to these letters. This is consistent with research protocol by Wood and Smith (2016). Four schools were visited per day. At each school, the researcher explained the purpose of her visit to the school head. She also explained what the study was about and the expectations of the subjects and how data will be collected from them. The researcher requested for the teachers' list and the list of HODs on the same day of dropping letters. School heads were also informed of the procedure of selecting subjects.

The researcher then arranged with the school head when to meet the subjects. In these meetings, the researcher introduced herself to the subjects. She explained the purpose of the study and the roles they were expected to play. The researcher also requested the subjects to feel free to seek clarity on the questions and also to answer to the best of their knowledge. Subjects were informed that their responses will be kept confidential. Two weeks was set aside for this task. Data collection then started the following week.

Out of fourteen (14) heads of departments from Mochudi schools, eleven (11) were interviewed. Almost all School Heads requested the researcher to use afternoon times for the whole data collection process. The researcher interviewed three HODs per week.

Questionnaires were administered to seventy (70) selected teachers and they were also administered on the same days of the interview. In each school, the researcher took about thirty minutes to explain words used in the instruments, as well as instructions in the questionnaire. Questionnaires were completed by teachers on the day they were received. They filled the questionnaires on their own. The researcher first distributed questionnaires to teachers then started the interview. This gave teachers time to fill the questionnaires while HODs' interviews were on and it also saved time because data was collected at the same time. Another advantage of collecting data at the same time is to prevent distortion of

information and data contamination which may occur when respondents meet during data collection (Kabir, 2016).

Teachers were given one hour to complete the questionnaire and to drop them at the School Head's office while the interview took one and half hours. This means that the researcher spent about two hours at each school. Out of seventy (70) questionnaires, sixty-three (63) were completed and returned to the researcher. Seven questionnaires were not returned.

3.8 Data Analysis

A quantitative method was used to analyse quantitative data and this analysis includedfrequency distributions of responses and ratings of average response specified in percentages. These analysis models attempted to obtain and interpret data on the following themes; usage of basic operations games in mathematics lessons, learners' arousal of interest by basic operations games, enhancement of the acquisition of the mathematical language by basic operations games, and examples of basic operations games.

Section 3 of the questionnaire collected qualitative data which was categorised into the following themes; Usage of basic operations games in mathematics lessons, Teachers' perceptions on arousal of learner interest by basic operations games, Teachers' perceptions on enhancement of learners' acquisition of mathematical language by basic operation games and Basic operation games which enhance the acquisition of the mathematical language. These themes were coded and analysed both qualitatively and quantitatively to ensure that the results are reliable (Zohrabi, 2013). The idea of coding used in this study was adapted from Taylor and Gibbs (2010). This analytic coding assisted the researcher in answering the four research questions of the study.

The researcher explained each finding of the study and established how the findings answered the research questions. Simple vocabulary was used to analyse the findings of the study and difficult terms that were found in the data were defined. This will help readers to understand the findings of the study.

3.9 Ethical Considerations

The researcher asked for permission from the regional education office in Mochudi and also from the School Heads of the selected schools. Before data collection, the researcher met up with the selected subjects at their respective schools and informed them how the selection process was carried out. The researcher explained the purpose of the study to the subjects. They were also informed that they were not forced to participate in this study and that they can withdraw at any time. Sibinga (2018) emphasizes confidentiality and anonymity so that subjects cannot be identified, harmed or deceived anyhow. The subjects of this study were reassured that their identity and the information they provide will be kept confidential. They were informed that the information will be used for research purposes only.

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND DISCUSSION OF RESULTS

4.1 Introduction

This chapter focuses on data presentation and analysis as well as discussion of results. The chapter is divided into two sections. The first section presents and analyses data collected. The section also identifies, simplifies and categorizes main ideas of the data. The second section discusses the results. In this section, main ideas found in the data are discussed and related to the problem of study as well as the research questions.

4.2 Data Presentation and Analysis

This section consists of four sub-sections which are; usage of basic operations games in mathematics lessons, arousal of learner interest by basic operations games, learners' acquisition of mathematical language by basic operation games and basic operation games which enhance the acquisition of the mathematical language. These sub-sections are themes that have been derived from the research questions.

Of the seventy (70) teachers who were targeted, only sixty-three (63) completed and returned the distributed questionnaires. This implies that ninety percent (90%) of the questionnaires were returned.

The interview was meant for fourteen (14) Heads of Departments (HODs) that is one HOD from each of the fourteen Mochudi primary schools. Only eleven HODs were interviewed. Three could not avail themselves. This means that 79% of the respondents was interviewed. The percentage of the respondents who returned questionnaires (90%) and that of the interviewees (79%) formed a sample that represented the population of teachers in Mochudi Primary Schools.

Frequency distributions were used to present quantitative data from questionnaires, more especially the closed ended questions. The ratings of average responses were specified in percentages. Qualitative data in the interviews and section C of the questionnaire was categorised into the following themes; Usage of basic operations games in mathematics lessons, Teachers' perceptions on arousal of learner interest by basic operations games, Teachers' perceptions on enhancement of learners' acquisition of mathematical language by basic operation games and Suggested examples of basic operation games which enhance the acquisition of the mathematical language. These themes were coded and analysed both qualitatively and quantitatively to ensure that the results are reliable. According to Zohrabi (2013) coding and analysing data using both qualitative and quantitative methods lead to more dependable results. Coding also leads to easy interpretation of results. This means that the results from data that is coded and analysed numerically and descriptively can be trusted. It also means that when data is coded, it becomes easy for people to read it.

4.2.1 Usage of basic operations games in mathematics lessons

Usage of basic operation games in mathematics lessons is a theme which was derived from research question 1. The research question was; What are the teachers' perceptions on usage of basic operations games in mathematics lessons in Mochudi area primary schools? The first two items of section 1 in the teacher questionnaire are some of the items which focused on collecting data on the above theme. These items were as follows;

Item 1: Do you ever use basic operations games to teach mathematics?

Item 2: Do teachers in your school use basic operations games in mathematics teaching?

The table below presents data collected on the above items.

Table 2

Usage of basic operations games in mathematics lessons

Item	Yes N (%)	No N (%)	No Response N (%)	Total
1	14(22)	49(78)	0(0)	63
2	21(33)	38(60)	4(6)	63

The table shows usage of basic operations games in mathematics lessons. Out of sixty-three respondents to item 1, only fourteen (22%) indicated that they use basic operations games in mathematics teaching. Forty-nine respondents (78%) said they do not use basic operations games in mathematics lessons.

Table 2 also shows the results for item 2 in which twenty-one respondents (33%) indicated that teachers in their schools use basic operations games to teach mathematics. Thirty-eight respondents (60%) said that teachers in their schools do not use basic operations games to teach mathematics. The remaining four respondents (6%) did not respond to this item.

Reasons for using basic operations games were revealed by data gleaned from items 1 and 2 in section 3 of the questionnaire. The items were seeking views on usage of basic operation games to enhance learner acquisition of mathematical language. Responses to the two items revealed reasons for using basic operations games. The reasons mentioned by the participants include;

- To arouse learners' interest in the mathematics lesson.
- To ensure that mathematics lessons are learner-centred.

As teachers answered item 1 in section 3 of the questionnaire, they revealed that games are time consuming as a reason for non-usage of basic operation games. The respondents

indicated that games prolong lessons and this hinders them from completing syllabus objectives on time. Ten out of sixty-three respondents of the questionnaire (15.9%) mentioned this reason. In item 1, respondents revealed that lack of resources needed by learners to play basic operations games also hinders them from using games in mathematics lessons. This was mentioned by twelve questionnaire respondents out of sixty-three (19%).

Out of sixty-three questionnaire respondents, sixty-two (98.5%) responded to item 2 in section 3. All the sixty-two respondents indicated that basic operations games enhance the acquisition of the mathematical language. When elaborating their answers, thirty-eight out of sixty-two respondents (61.3%) mentioned that learners quickly grasp mathematical concepts in games because they enjoy playing. Among the remaining respondents, nineteen (30.6%) indicated that games are practical and so they enhance mathematics learning because young learners learn by doing. Five respondents (8.1%) did not elaborate their answers to item 2.

Interview data also sought data on the usage of basic operation games in mathematics lessons. Out of eleven HODs interviewed, three (27%) indicated that teachers in their schools use basic operations games in mathematics lessons. Eight respondents (73%) said that teachers do not use basic operations games in mathematics teaching. The three respondents who indicated that teachers in their schools use basic operations games elaborated their responses by mentioning that the teachers usually use these games in the 'games and puzzles' topic. "*Ba ba itshwenyang ba di dirisa, o fitlhela ba di dirisa mo thopiking ya games and puzzles, because it compels them to do so and of course some are operations games…*," said one of the three respondents. This can be loosely translated to English to mean; "Those who use them (referring to games), usually use them in the games and puzzles topic because it compels them to do so and of course some are operations games."

Data on the interviewed HODs on usage of basic operation games also mentioned two reasons that basic operation games arouse learners' interest in mathematics lessons and that

they make the lessons to be learner-centred. The respondents further indicated that basic operations games engage learners fully in the lesson, enabling them to manipulate objects and play active roles. According to respondents, when learners are allowed to play games, it becomes easier for them to learn the concepts in the games and they would not easily forget them. One HOD said, "*Hey mma, bathonyana ba, ba a lebala tota* (These children forget too much) *but if we teach them something through a game, they don't forget it…It stays in their minds forever. Tota nnete ke gore* (Actually the truth is that) *teachers are lazy to research and come up with suitable games for the topics they have to teach... Le nna ke le mo teng,* (including myself)" and she laughed. The implication is that for learners to grasp mathematical content and not forget it, they need to be engaged in games where they do things for themselves.

Two HODs also pointed out that if learners can be allowed to play games, they would gain mental strength as they would be required to think critically and make sound decisions that can enable them to win the game. *"…and usually gaming results in good performance, even in the intellectually challenged ones,"* commented one of the HODs. This means that basic operations games can improve thinking and capability of learners and it also promotes problem-solving skills as they would be required to make decisions on their own. The verbatim from the HOD also implied that basic operations games can lead to good performance even in learners who under-perform.

Data from the interviews revealed reasons for not using basic operations games which include teachers' laziness to research, teachers' view that games are time-consuming and lack of resources. The respondents also revealed that teachers do not use basic operations games because they are lazy to research for the topics they have to teach. This means that teachers should not just let learners play any game they want. It means that teachers should find games that relate to the topic and one that really teaches the syllabus objective for the day.

The eleven HODs indicated that basic operations games are time-consuming. This shows that some teachers avoid using basic operations games in mathematics teaching because they believe that the lessons would be time consuming.

The respondents gave examples of resources that are needed to teach mathematics. The resources included; board games such as monopoly, darts, snakes and ladders as well as puzzles. The implication here is that, teachers do not teach mathematics through basic operation games because some materials that learners need in gaming are not available in schools.

4.2.2 Teachers' perceptions on arousal of learner-interest by basic operations games

The theme of teachers' perceptions on arousal of learners' interest by basic operations games was addressed by items 3 and 5 in section 1 of the teacher questionnaire. This theme was derived from research question 2 of the study which sought to establish teachers' perceptions on the extent to which basic operations games arouse learners' interest in the mathematics lessons. The items were;

Item 3: Do teachers use basic operations games to arouse learners' interest in mathematics lessons?

Item 5: Do learners get bored in mathematics lessons when basic operations games are used?

Data obtained are presented in table 3. Twenty-two respondents out of a total of sixty-three (35%) said that teachers use basic operations games to arouse learners' interest in mathematics lessons. The remaining forty-one respondents (65%) said that teachers do not use basic operations games to arouse learners' interest in mathematics lessons.

Table 3

Teachers' perceptions on arousal of learner interest by basic operations games

Item	Yes N (%)	No N (%)	No Response N (%)	Total
3	22(35)	41(65)	0(0)	63(100)
5	0(0)	63(100)	0(0)	63(100)

These results show that a high number of respondents said other teachers do not use basic operations games in mathematics teaching. Data also shows that all the sixty-three respondents (100%) ticked 'no' in their response to item 5. This indicates that teachers believe that learners do not get bored when mathematics lessons are taught through basic operations games, implying that they enjoy such lessons.

Interviews also sought data on the teachers' perceptions on arousal of learners' interest by basic operations games through item 2. All the eleven respondents said basic operations games can be used to arouse learners' interest in mathematics lessons. The respondents were further required to describe the level of learners' interest in mathematics lessons when basic operations games are used. Out of the three levels of high, average and low, all respondents indicated that the level of learners' interest is high when basic operations games are used.

The results of the study from both the questionnaire and interview which were responding to arousal of learners' interest indicated that a high number of teachers do not use basic operations games to arouse learners' interest in mathematics lessons. However, the results also show that even though teachers do not use basic operations games to arouse learners' interest in mathematics, they believe that these games can arouse learners' interest at a higher extent.

4.2.3 Teachers' perceptions on learners' acquisition of the mathematical language through games

The theme in this sub-section was derived from research question 3 which was seeking teachers' perceptions on the extent to which basic operations games enhance learners' acquisition of the mathematical language. Data obtained on teachers' perceptions on enhancement of learners' acquisition of mathematical language are presented in table 4. The table presents four items related to the theme which were in section 2 of the questionnaire and they were as follows;

Item 2: Basic operations games enhance learners' acquisition of mathematics language.

Item 4: Do basic operations games enhance the acquisition of the mathematics language?

Item 7: Some foreign basic operations games can enhance learners' acquisition of mathematical language.

Item 8: There are no mathematical concepts that can be taught through basic operations games.

Thirty-seven respondents out of sixty three (59%) strongly agreed that basic operations games can enhance learners' acquisition of the mathematics language. The remaining twenty-six respondents (41%) fell in the 'agree' category. This implies that all the sixty- three respondents (100%) believe that basic operations games can enhance the acquisition of mathematics language. The results of item 4 showed that all the sixty- three respondents (100%) strongly agreed that learners can acquire mathematical language through basic operations games. This means that when basic operations games are used, learners can quickly grasp the content taught. In other words this it implies that the games can be used to teach mathematical language and content.

Table 4

Teachers' perceptions on enhancement of learners' acquisition of mathematical language

Item	SA (%)	A (%)	N (%)	D (%)	SD (%)
2	37(59)	26(41)	0(0)	0(0)	0(0)
4	63(100)	0(0)	0(0)	0(0)	0(0)
7	37(59)	26(41)	0(0)	0(0)	0(0)
8	0(0)	0(0)	2(3)	6(10)	55(87)

Results for item 2 and 7 are the same. Responses show that thirty-seven respondents (59%) out of sixty three are in the 'strongly agree' category and twenty-six (41%) in the 'agree' category in both items. Thus all respondents (100%) believe that some foreign basic operations games can enhance learners' acquisition of the mathematical language. As for item 8, fifty-five respondents (87%) out of sixty three strongly disagreed that there are no mathematical concepts that can be taught through basic operations games. Six disagreed with the statement (10%) and the remaining two respondents (3%) did not indicate their response.

In the interview, HODs were asked whether teachers in their schools use basic operations games to enhance the acquisition of the mathematics language. Three interview respondents agreed. Eight respondents believed that their teachers do not use basic operations games to enhance the acquisition of mathematical language. On issues of potential of basic games, all the eleven respondents said that learners can acquire mathematical language from basic operations games. This means that majority of HODs believe that basic operations games can enhance the learning of the mathematical language but they do not use these games.

4.2.4 Basic operations games which enhance the acquisition of the mathematical language

Basic operations games which enhance learners' acquisition of the mathematical language was derived from research question 4 which sought to establish teachers' perceptions on the examples of games which teach basic operations. Questionnaires and interviews sought data on basic operations games and the mathematical language that each game promotes. The data obtained was analysed and categorised into traditional and foreign games. This subsection presents two categories of games which are traditional and foreign games. In each category, games are listed together with the mathematical language they promote.

4.2.4.1 Local games and basic operations

Data from the questionnaires revealed the local basic operation games and the mathematical language the games promote. The outcome is presented in table 5.

Table 5

Local basic operations games and mathematical language they promote

Local basic operations games	Mathematical language in it
Morabaraba (mhele)	Add, plus, minus, subtract, divide, multiply, multiples of different numbers, remainder.
Dibeke	Times 2, multiplying by 2, double, back to zero, subtract
Skipping rope (koi)	Add, plus, subtract, minus, multiply, product, times, divide, quotient, double, twice, triple, thrice, counting numbers
Ma-roundas	times 4, multiplying by 4, back to zero, multiples of 4
Hide and seek	Plus, minus, back to zero, counting numbers
Diketo	Add, plus, minus, subtract, divide, multiply, multiples of different numbers, remainder.

HODs in their interviews also revealed the same local games as those mentioned by teachers. The HODs described the skipping rope as follows; two players hold the ends of the rope and they move it according to the rhythm of the song or verse. Other players have to skip it rhythmically, ensuring that it does not trip them over. If it does, they are out. Players gain points as they skip the rope up to the end of the song or verse. Every player who successfully skips continuously up to the end of the song or verse gains a point or points. Teams have to decide whether they count in ones, twos and so on. A team with more points wins. This game promotes the acquisition of addition and multiplication terms because as players add points, they use words like 'plus' and 'add'. They also learn multiplication as they count points and they use words such as 'times' and 'multiply by'.

In hide and seek, the HODs said a player (also referred to as the leader) stays at the base and he/she is blind-folded. This player has to count up to the agreed number while other players hide. After counting, the player removes the blindfold and looks for others. Any player who reaches the base before the leader gains a point. A player with more points wins. According to the HODs, to determine who the winner is, players compare points and they use terms like 'greater than', less than' and 'equal'. The game may also be used to introduce the symbols; >, < and = to compare numbers.

When elaborating the answers to items 1 and 6 of the interview, respondents also revealed one or more mathematical terms or language that may be learnt from each basic operation game. There are many mathematical terms that have been mentioned and those which were mentioned in most cultural basic operations games were add, minus, multiply, divide, remainder, multiple, double and counting numbers.

Mathematical terms obtained through a questionnaire are shown in table 4. Examples include add, plus, minus, subtract, divide, multiply, multiples of different numbers, remainder, times, double, thrice, twice, triple, counting numbers, back to zero, product and

quotient. Most of the mathematical terms obtained through a questionnaire are the same as those obtained through interviews. The mathematical terms somehow relate to the basic operations.

"*Local games are better than foreign ones because, they already know them. So we don't have to struggle to teach them. The games use mother-tongue, so everyone participates, even the weak ones*…," uttered one of the HODs as she was asked to justify the use of local games in mathematics lessons. This implies that teachers who use games in mathematics teaching prefer to use local games because they will not have to spend a lot of time and energy trying to teach them the game. Again, local basic operations games are better in the sense that they use vernacular; the language known by the majority and this caters for all learners in the different ability levels. In this case, it would mean that teachers have to translate vernacular terms in the games to English because mathematics tests are written in English.

4.2.4.2 Foreign games and basic operations

Data obtained from questionnaires also revealed ten foreign basic operation games and the mathematical language promoted. The outcome is presented in table 6.

Table 6

Foreign basic operations games and mathematical language they promote

Foreign basic operations games	Mathematical language
Mathematics riddles	Add, plus, subtract, minus, multiply, product, divide, quotient, dividend, double, twice, triple, thrice, greater than, more than, less than
Monopoly	Add, plus, subtract, minus, multiply, product, divide, quotient, double, twice, triple, thrice
Mathematics puzzles	Add, plus, subtract, minus, multiply, product, times, divide, quotient, dividend, double, twice, triple, thrice, greater than, less than, dividing, equivalent fractions, decimal, mixed number, proper fractions, improper fractions, numerator, denominator
Mathematics quizzes	Add, plus, subtract, minus, multiply, product, divide, quotient, dividend, double, twice, triple, thrice, greater than, less than
Snakes and ladders	Add, plus, subtract, minus, multiply, product, divide, quotient, double, twice, triple, thrice, greater than, less than, back to zero
Darts	Double, triple, add, plus, times, multiply by
Scotch	Plus, minus, times, multiples, double, triple, twice, thrice
Bingo	Problem solving, plus, minus, divide, multiply, times, multiple, factor.
Odd one out	Plus, minus, times, multiple, factor, number-sequence, number patterns, output, input
Shop game	Change, total, unit price, bill, add, subtract, multiply, divide

The interview with HODs also requested them to mention foreign games that could be used in teaching mathematics. They mentioned the following; computer-games, snakes and ladders, monopoly, mathematics puzzles and riddles, mathematics quizzes, shop-game and odd one out.

These results show that most of the basic operations games mentioned teach all the four operations. Such games are morabaraba, dibeke, ma-roundas, riddles, puzzles, quizzes, snakes and ladders, odd one out and shop game. Skipping rope as well as hide and seek are the basic operations games that do not teach all the four operations.

4.3 Discussion of Results

This section discusses results by relating them to the problem of study as well as to the research questions. In this section, literature was used to compare the outcome of this study to outcomes of related studies. Much of the literature consulted focuses on usage of games in mathematics teaching. Very little focuses on basic operations in particular. However, this knowledge was helpful in assisting to answer research questions of this study.

The discussion is divided into four sub-sections: Usage of basic operations games in mathematics lessons; Teachers' perceptions on arousal of learner interest by basic operations games; Teachers' perceptions on enhancement of learners' acquisition of mathematical language by basic operation games; and Suggested examples of basic operation games which enhance the acquisition of the mathematical language. These sub-sections are themes that have been derived from the four research questions of the study.

4.3.1Usage of basic operations games in mathematics lessons

Data from the questionnaires and interviews indicated that in Mochudi primary schools, basic operations games are rarely used in the teaching of mathematics. This is evidenced by a high number of respondents of this study (60%) who said they do not use basic operations games in mathematics lessons. Studies on games and mathematics teaching concur with these

results as they also revealed that teachers do not use games to teach mathematics (Bose & Seetso, 2016; Ekonesi & Ekwueme 2011; Machaba, 2013). This may imply that school leadership is not doing enough to ensure that teachers use the recommended methods such as games to teach mathematics. Where there is lack of resources, in some instances schools may buy such resources or teachers can improvise with what is available.

Questionnaire and interview data also showed that teachers who use basic operations games are usually seen using these games when teaching the topic; games and puzzles. These results showed that the nature of this topic makes teachers to use games. Gail and Taylor (2007) studied the teaching of mathematics through games and puzzles and their study revealed that very few teachers use games in the different mathematics topics, including the topic, 'Games and puzzles'. Other studies indicated that different mathematical concepts, social and problem solving skills in mathematics can be taught through mathematics games (Bose & Seetso, 2016; Winter, 2007). Furthermore, teachers can formulate their own games that would teach what they want (Way, 2011). This implies that even though any topic can be taught through basic operations games, teachers do not use games to teach mathematics topics except when teaching the topic 'games and puzzles.' Teachers are able to use games when it comes to 'games and puzzles' which may mean that they have the knowledge to apply games in mathematics teaching but they do not have the passion to do so.

The study revealed reasons why teachers in use basic operations games in mathematics lessons. One reason revealed by more than half of the respondents (54.5%) is that basic operations games arouse learners' interest in mathematics lessons. Results of the studies by Akinsola (1994), Bose and Seetso (2016), Drigas and Pappas (2015), Ekonesi and Ekwueme(2011) and Gerdes (1994) concur with results of this study as they also show that games are a source of enjoyment for learners. The studies also revealed that games motivate learners in the mathematics lessons. This means that basic operations games can make

learners enjoy mathematics lessons. However, linking this result to the one on usage of basic operations games, it shows teachers know that basic operations games are interesting to learners and yet they do not use them to teach mathematics.

Studies by Akinsola (1994), Ekonesi and Ekwueme (2011), Kekana (2016) and Nkopodi and Mosimege (2009) revealed that if mathematics lessons are taught through games, most learners participate in the lessons, even the low-achievers. This implies that most learners become fully engaged in mathematics lessons when basic operations games are used.

Another reason for using basic operations games as mentioned by the respondents (27.3%) was that games are learner-centred. This percentage is very low and it may imply that many teachers do not believe that basic operations games are learner centred. This calls for in-service education on game enhanced learning. Akinsola (1994), Aremu (1999) together with Bose and Seetso (2016) share the same sentiments that simulating teaching methods such as games make learners to discover solutions to problems on their own. This implies that the use of basic operations games should be promoted through teacher education.

Interview data revealed teachers' perceptions that when learners are engaged in basic operations games, they develop mental strength which makes them to remember concepts they learnt. According to Piaget (1936), play develops the children's cognition, understanding and the actions they should take given situations. Similarly, Nkopodi and Mosimege (2009) contend that usage of games promotes learners' concentration and enables them to share knowledge. Bose and Seetso (2016) on the other hand revealed that games promote learners' memory development. This implies that teaching learners through basic operations games can promote their reasoning and concentration capability. Learners with reasoning and concentration capabilities are able to recall what they have been taught and they also apply problem solving skills to come up with their own solutions (Nisbet& Williams, 2009).

One of the reasons for non-usage of basic operations games which was revealed by this study was that games are time-consuming. Other researchers (Akinsola, 1994; Garegae-Garekwe, 1994; Gerdes, 1994; Winter, 2007) have also revealed that games consume a lot of time. This means that lessons that are taught through games take a long time and that is why teachers avoid using them. Bragg (2012) and Gerdes contend that games take long especially if they are not well-planned. They believe that teachers should make good choices of games before using them. This implies that if suitable mathematics games are used and teachers have knowledge of the games they use, then mathematics lessons will not take a long time to finish.

Data from teacher questionnaires and interviews of HODs indicated that teachers do not use basic operations games in mathematics lessons because they are lazy to research on topics. Some of the teachers, who use games in teaching, do so without a proper understanding of such games while others avoid using games altogether (Akinsola, 1994; Aremu, 1999; Haystead&Marzano, 2009). This means that teachers do not have knowledge of games and as a result, they either use games without understanding or they opt not to use them altogether. Haystead and Marzano also revealed that children spend a lot of time playing games at home and when they are out chatting with friends but at school they are not given the opportunity to play games. This means that when children are on their own they choose to play games and when they are at school they are restricted from gaming.

Another reason for not using basic operation games more often, as revealed by the results, was that schools do not have the required resources. This simply means that sometimes teachers do not use basic operation games in mathematics lessons because there is lack of equipment and materials in their schools. In their response to the issue of lack of resources, the HODs indicated that teachers should improvise and only a few are able to. This implies that teachers are expected to make their own teaching aids out of any available

materials they find. However, literature also revealed that what learners need during gaming is mathematics power and not the resources (Rutherford, 2015). The implication is that games can still be played even if there are no materials. This nullifies the reason that basic operations games are not used in mathematics lessons because there are no resources.

4.3.2 Teachers' perceptions on arousal of learner interest by basic operations games

Respondents in this study reported that basic operations games arouse learner interest in mathematics lessons. Games make learners to enjoy mathematics lessons (Aremu, 1999; Bragg, 2012; Ekonesi & Ekwueme 2011; Machaba, 2013). This implies that learners like playing games and if used in mathematics lessons, they end up enjoying the subject.

The study showed a high number of respondents (100%) who indicated that the level of learners' interest becomes high if basic operations games are used in mathematics lessons. HODs also believe that if basic operations games can be used in the lessons, the level of learners' interest will be high. Studies by Akinsola (1994) and Gerdes (1994), which were, on the use of games in mathematics teaching also reported high learner interest in the lessons when games were used. This means that games make learners to enjoy mathematics lessons more.

4.3.3 Teachers' perceptions on learners' acquisition of mathematical language through games

Data in this section helped the researcher to answer research question 3 which was; what are the teachers' perceptions on the extent to which basic operations games enhance the acquisition of the mathematical language?

Piaget (1962) advocated for play in children's learning since learning occurs faster. This means that if teachers engage learners in play such as games, they will learn on their own and they will easily understand what they are taught as compared to when games are not used.

HODs' perceptions were revealed during interviews that basic operations games can be used in mathematics lessons to teach mathematical language. Akinsola (1994), Aremu (1999), Bose and Seetso (2016), Gerdes (1994) and Winter (2007) did studies which also

revealed that games can enhance mathematical language. This suggests that teachers could teach mathematical concepts through basic operation games.

In an interview, one HOD revealed her view that basic operation games enable learners to retain information in their brains for a longer time.Studies carried out by other researchers (for example; Akinsola, 1994; Bose & Seetso, 2016; Nisbet & Williams, 2009) also share the same sentiments that when learners play games they are able to recall what they have been taught through such games. This implies that learners do not easily forget what they have learnt from games. It also means that it becomes easier for them to recall what they did or said when they were playing games. The implication here is that when learners are able to remember what they have been taught through basic operations games then it means that they have acquired the mathematical language that the teacher intended to teach them.

4.3.4 Basic operation games which enhance learners' acquisition of the mathematical language

Data in this section assisted in answering research question 4 which sought to establish games that could be used in primary school mathematics teaching to enhance learners' acquisition of the mathematical language. The results of the study revealed that there a number of basic operation games which enhance the acquisition of mathematical language. Such games include traditional games; morabaraba, dibeke and skipping rope. Nkopodi and Mosimege (2009) also revealed the following traditional games; morabaraba, dibeke and diketo. Examples of foreign games that teach mathematical languages as mentioned in the study are mathematics puzzles and monopoly. Bragg (2012) also revealed similar foreign basic operations games which are mathematics puzzles, monopoly and computer games. Interview data revealed that there are many different computer games that can be used to enhance mathematics learning. The study mentioned the following examples of computer games; snakes and ladders, mathematics puzzles and quizzes.

This study also required respondents to mention games that promote basic operations. Common basic operation language or concepts which can be acquired from basic operations games revealed by this study include; add, subtract, plus, minus, times, multiply, product, divisor, quotient and dividend. These results are in line with Hobbs and Brown (2016) who contend that mathematics games are effective tools that should be used to teach mathematical concepts like add, subtract, divide and multiply.

The study investigated teachers' perceptions on the extent to which basic operations games enhance learners' development of the mathematical language. One of the findings is that teachers in Mochudi primary schools rarely use basic operations games in mathematics lessons. Some of the reasons for not using basic operations games were that games are time consuming and respondents also mentioned that schools do not have resources needed to play games. Even though a small number of respondents indicated that they use basic operations games to teach mathematics, majority of the respondents revealed that basic operations games arouse learner interest and that the games can enhance the acquisition of the mathematical language.

The study also revealed that there are local and foreign basic operations games that can teach mathematical concepts. Examples of local basic operations games mentioned include; morabaraba, dibeke, diketo and ma-roundas. Foreign basic operations games include; mathematical puzzles and riddles, snakes and ladders, mathematical quizzes and monopoly. Local basic operations games that teach addition and subtraction include; morabaraba, dibeke and diketo. Those that teach multiplication and division include morabaraba and skipping rope.

CHAPTER FIVE
SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

This chapter consists of summary of the study, conclusion and recommendations. This section also shows the extent to which the study has attempted to address the problem statement of this study.

5.2 Summary of the Study

The summary offers a synopsis of the undertaken study, covering the following;purpose of the study, the problem statement as well as key results which set this study in motion. This study was conducted with the aim of investigating primary school teachers' views on the extent to which basic operations games enhance the acquisition of learners' mathematical language. Primary School Leaving Examination (PSLE) reports revealed that generally learners in Botswana primary schools post poor performance in mathematics. Thisstudy has attempted to respond to this outcry with sheer consideration that learner-centred strategies such as games can enhance the acquisition of the mathematical language and ultimately improve learner performance in mathematics (Bose and Seetso, 2016). The study focused on the usage of basic operations games as a learner-centred approach that can enhance the acquisition of the mathematical language.

Data for this study was obtained from sixty-three teachers and eleven HODs randomly sampled from fourteen Mochudi primary schools. A mixed method design was used for data collection and analysis. Section 1 and 2 of the questionnaire collected quantitative data from teachers while interview and section 3 of the questionnaire collected qualitative data from HODs and teachers respectively. Tables were used to present quantitative data while coding of data was used to present and analyse qualitative data. Coding was applied by deriving

themes from the research questions of this study and data was categorised under the themes to show the relationships of ideas.

Research question 1 sought to establish the basic operations games used in Mochudi primary schools during mathematics teaching. The results of the study revealed that most of the teachers do not use games in mathematics lessons. The results of the study also revealed that even though teachers do not use basic operations games in mathematics teaching, they know the benefits of using these games in mathematics lessons.

Research question 2 sought data of teachers' perceptions on the extent to which basic operations games arouse learner-interest in mathematics lessons. All the respondents believed that games arouse learner-interest in mathematics lessons.

Respondents revealed that basic operations games also teach learners new mathematical concepts and that learners perform better in mathematics if allowed to play these games. These results answered research question 3 which wanted teachers' to express their perceptions on the extent to which basic operations games enhance learners' acquisition of the mathematical language. The implication of these results is that games enhance the learning of the mathematical language at a higher extent. The mathematical language that may be learnt from basic operations games include; add, plus, minus, subtract, divide, multiply, multiples of different numbers, remainder, times, double, thrice, twice, triple, counting numbers, back to zero, product and quotient.

The last research question sought examples of basic operations games that may be used to enhance learners' acquisition of the mathematical language. Traditional basic operations games which were revealed include; morabaraba, dibeke, skipping rope, ma-roundas, hide and seek and diketo. Foreign basic operations games revealed include; mathematics-riddles, monopoly, mathematics puzzles, mathematics quizzes as well as snakes and ladders. The results also revealed that most of these games can be used to teach the four basic operations.

5.3 Conclusion

The results of this study are based on perceptions of primary school teachers in Mochudi. It must therefore be noted that the conclusive statements made on them need to be verified by experimental research in which lesson observations and testing of learner performance would be done. This study advocates for usage of basic operations games not only to teach games and puzzles but also to teach other mathematics topics. It is important to allow learners to interact by playing games so that they enjoy as well as acquire mathematical knowledge and skills which the teacher wants them to learn. According to teachers' perceptions gathered in this study learners perform better when games are used. This may imply that there is a relationship between usage of games in mathematics teaching and learner performance. However, an experimental study may be carried out to prove whether this relationship really exists.

The study also calls for the review of the current primary school mathematics syllabus so that the use of games is emphasized in the different topics. This would emphasize play in the classroom which is advocated for by the educational theorists.

In this study, very few teachers were found to be using games in mathematics lessons. This implies that teachers, the school leadership and the MOBE should work jointly towards successful use of games in mathematics learning. In this endeavour MOBE and school leadership should provide the necessary resources, teacher education programmes and intensify classroom supervision in schools. All teachers should ensure that they use basic operations games in mathematics teaching at all times. They should also engage in research and make a good choice of games which are relevant to what they teach. Mathematics performance will not improve if games are used haphazardly. In some cases, it may be wise to use traditional games, so that learners are taught from known to unknown, as proven by educational research.

5.4 Recommendations

This section reveals suggestions on improving usage of basic operations games in mathematics lessons so that learners can acquire as much mathematical language as possible. Based on the results, this study has made the following recommendations;-

- The Ministry of Basic Education, Parents and Teachers Associations (PTAs) as well as the business community should have a joint venture in the provision of mathematical games and other teaching aids in schools.
- The Ministry of Basic Education should review the current mathematics curriculum to accommodate usage of games in a number of topics.
- The regional education offices and schools should mount regular in-service workshops that reinforce usage of games in the teaching of primary school mathematics.
- School leadership and mathematics researchers should undertake classroom observations to investigate how teachers use games in the teaching of mathematics.

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APPENDICES

Appendix A: Interview guide for Heads of Departments

THE INTERVIEW GUIDE FOR HEADS OF DEPARTMENTS

Section A: Usage of basic operations games in mathematics lessons

1. Do teachers in your school use basic operations games in mathematics lessons? Give the reasons why you think teachers use (or they don't use) these games.

Section B: Teachers' perceptions on arousal of interest by basic operations games

2. Can basic operations be used to arouse learners' interest in mathematics lessons? If yes, give examples of such games.

3. Describe the level of learner-interest when basic operation games are used. Explain why that is so.

Section C: Teachers' perceptions on learners' acquisition of mathematical language through basic operations games.

4. Do teachers in your school use basic operations games to enhance the acquisition of the mathematical language?
   In your view, why do they use (or not use) these games to enhance mathematical language acquisition?

5. In your view, can learners acquire some mathematical language through basic operation games? Support your answer.

Section D: Examples of basic operations games which enhance acquisition of mathematical language.

6. If you were to teach mathematical language through the use of basic operations games, which games would you use to teach the following concepts? Explain the mathematical language in each of those games.

   (a) Addition
   (b) Subtraction
   (c) Multiplication
   (d) Division

THANK YOU!

Appendix B: Questionnaire for teachers

TEACHER QUESTIONNAIRE

Introduction

I am a final year master of Education student at the University of Botswana, conducting a study on "Primary School teachers' views on the extent to which basic operations-games enhance the acquisition of the learners' mathematical language: Case of Mochudi Primary Schools."

I present this questionnaire as a data collecting instrument for my study. Please answer it to the best of your knowledge. All the information contained in it will be kept as confidential as possible.

Instructions

1. This questionnaire has three sections. Answer all of them. The first section has 'YES' and 'NO' questions. In the second section, you are required to indicate your level of agreement/disagreement by making a tick (√) in the appropriate box. The last section consists of open-ended questions which seek you to express your opinions fully.

Section 1

There are six questions in this section. For each question, make a tick (√) under 'YES' or 'NO' to show your response. Please answer all the questions.

Items	YES	No
1. Do you ever use basic operations games to teach mathematics?		
2. Do teachers in your school use basic operations games in mathematics teaching?		
3. Do teachers use basic operations games to arouse learners' interest in mathematics lessons?		
4. In your view, do basic operations games enhance the acquisition of the mathematics language?		
5. In your view, do learners get bored in mathematics lessons when basic operations games are used?		
6. In your view, can cultural games be used to teach mathematics language?		

Section 2

This section has eight statements. Please respond to them by ticking (√) in the appropriate box to show your level of agreement or disagreement.

Note: SA stands for Strongly Agree, A stands for Agree, N stands for Neutral, D stands for Disagree and SD stands for Strongly Disagree.

Statement	SA	A	N	D	SD
1. I use basic operations games in mathematics lessons.					
2. Basic operations games enhance learners' acquisition of mathematics language.					
3. Basic operations games make mathematics lessons boring.					
4. Basic operations games arouse learners' interest in mathematics.					
5. I never use games to teach basic operations.					
6. There are cultural games that can enhance learners' acquisition of the mathematics language.					
7. Some foreign basic operations games can enhance learners' acquisition of mathematical language.					
8. There are no mathematical concepts that can be taught through basic operations games.					

Section 3

This section consists of five open ended questions. Please answer all of them to the best of your knowledge.

1. Do you ever use basic operations games to enhance the learners' acquisition of the mathematical language? Give reason for your answer.

_____

_____

_____

_____

_____

2. In your view, do basic operations games enhance the acquisition of the mathematical language? Explain your answer.

_____

_____

_____

_____

_____

2. Which basic operations games do you often use to enhance the acquisition of the mathematical language?

a)_____

b)_____

c)_____

3. Are there any basic operations games that you know which can arouse learners' interest in mathematics? YES / NO

If yes, give three examples of such games.

(a)_____

(b)_____

(c)_____

4. With reference to your school, how do you rate the usage of games in the teaching of the basic operation-concepts? (Tick in the appropriate box).

Used more often	rarely	never
☐	☐	☐

THANK YOU!

Appendix C: Output of Cronbach’s Alpha

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.71	.833	8

Appendix D: Supervisor's cover letter (Request for permission)

UNIVERSITY of BOTSWANA

Faculty of Education

Department of Maths and Science Education

Corner of Notwane and Mobuto Road, Gaborone, Botswana
Pvt Bag 0022 Gaborone, Botswana
Tel: [267] 355 5130
Fax: [267] 318 5096
e-mail chakalis@mopipi.ub.

31st October 2017

Director
Kgatleng Region
P. O. Box 199
Mochudi

Dear Sir/Madam

Subject: Request for Permission to Conduct Research in Mochudi Primary Schools

The bearer Ms Onkemetse Modisane - Oteng of ID# 200208420 is a student at the University of Botswana enrolled in a Master in Education degree and currently undertaking ESM751: Research Essay in Mathematics Education. One requirement of the course is to undertake data collection on an identified research topic. Ms Modisane-Oteng has an approved topic titled **"Primary School teachers' views on the extent to which basic operations-games enhance the acquisition of the learners' mathematical language: Case of Mochudi Primary Schools.".**

The candidate intends to collect data from students and teachers in sampled Mochudi schools. I wish to request permission to have the student undertake this exercise as planned. It is anticipated that the data collection will take place in the month of November 2017.

Kindly approve

Yours sincerely

Dr Paul A. Chakalisa
Student Supervisor – Math and Science Education

Appendix E: Permission to conduct research study in Mochudi schools

SAVINGRAM

FROM: Director
Kgatleng Regional Operations

T.S. Masike-Mosothwane
For/ Director

TEL: 5777226
FAX: 5777879

TO: **School Heads - Primary School**

- Seingwaeng
- Isang
- Segale
- Mmusi
- Bogatsu
- Phaphane
- Matsieng
- Ntshinoge
- Kgafela
- Kgabosereto
- Mmadipamo
- Lady Mitchison
- Pilane
- Linchwe

REF: KGATL 1/13/1 III (72) PEO I- Primary 3rd November 2017

PERMISSION TO CONDUCT RESEARCH STUDY

This serves to inform your office that permission has been granted to Mrs Onkemetse N. Modisane–Oteng from University of Botswana to undertake a research study in your schools from 6th to 30th November 2017.

The title of the research study is: "**Primary School Teachers' View on the extent to which basic operations-games enhance the acquisition of the learners mathematical language; Case of Mochudi Primary Schools".**

You are therefore requested to assist her in anyway possible.

Thank you.

TSM/tnm

BOTSWANA

Appendix F: Request for permission to undertake research – School Heads

University of Botswana

Department of Maths& Science Education

Private Bag 0022

Gaborone

6 November 2017

The School Head

_____

_____

_____

Dear Sir/Madam

RE: REQUEST TO CARRY OUT A RESEARCH STUDY IN YOUR SCHOOL

I ONKEMETSE MODISANE-OTENG of student identity 200208420 and national Identity number 387420902, write to request your office to allow me to carry out a research study in your school. I am a third year student enrolled in the Masters of Education (Mathematics Education) program at the University of Botswana.

The purpose of the study is to fulfil the requirement of the Masters in Mathematics Education. The title of this study is, "Primary school teachers' views on the extent to which

basic operations games enhance the acquisition of the mathematical language - Case of Mochudi schools."

I hope your office will allow me to carry out this task.

Thank you.

Yours faithfully

_____

Onkemetse N. Modisane-Oteng