EXPLORING THE TEACHING OF CRITICAL THINKING SKILLS TO LEARNERS TO PROMOTE MATHEMATICAL LITERACY: A CASE OF FIVE SCHOOLS IN THE ZAKA DISTRICT OF ZIMBABWE

by

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Submitted in accordance with the requirements for the degree of

DOCTOR OF EDUCATION

In the subject

MATHEMATICS EDUCATION

at the

UNIVERSITY OF KWAZULU-NATAL

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STAFF NUMBER: 642131

2019

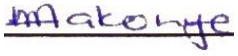
ABSTRACT

The present study explored the teaching of critical thinking skills to young learners in the 3-8-year age bracket during the teaching of mathematics teaching to enhance mathematical literacy in Zimbabwe. The impetus that led to this exploration was that mathematical literacy is not a standalone subject in Zimbabwe, but learners are expected to acquire critical thinking skills through the teaching of other subjects including mathematics. It was therefore important to the researcher to explore the teaching of critical thinking skills to young learners during mathematics teaching in the context of five primary schools conveniently sampled in Zaka District of Zimbabwe. The research study focused on finding out factors that are related to the development of critical thinking skills in young learners during the teaching of mathematics, how teachers facilitate the development of critical thinking skills in young learners during mathematics teaching and why there is a need to teach critical thinking skills to young learners during mathematics teaching. This study used a case study design embedded in qualitative approaches. Interviews, observations and document analysis in form of video records were used to generate data. Twenty-five teachers and all learners they teach (approximately 1500) participated in the study. It was established in the research study that culture was the major factor that negatively influenced the teaching of critical thinking skills to young learners. Some of the factors drawn from the study are chronological age, mental age, adult influence, socio-economic status of parents, emotional and intellectual support to the learner, and reinforcement of schoolwork, gender and age of the child. The research study also established that provision of teaching resources in terms of technological tools, learner activities; teacher activities and methodology in teaching were the basis for facilitating the development of critical thinking skills so as to promote mathematical literacy in learners. The research study further revealed that there was a need to teach critical thinking skills to enhance the following attributes in young learners: problem-solving, mental agility, lifelong learning, mathematical literacy, defining solutions to problems, and understanding of concepts, distinguishing by associating what they are learning to what they already know and independent thinking. Recommendations for future approaches to facilitate the development of critical thinking skills to learners in the 3-8-year age range to promote mathematical literacy were made in the context of research findings from primary schools in Zaka District of Zimbabwe.

DECLARATION

This research has not been previously accepted for any degree and is not being currently considered for any other degree at any other university. I declare that this thesis contains my own work except where specifically acknowledged.

LEAH MAKONYE

Signed: 

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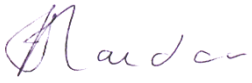
Signed: 

Date: 08 August 2019

DEDICATION

This thesis is dedicated to my husband, Godfrey Makonye, for his moral support throughout this academic journey.

ACKNOWLEDGEMENTS

No undertaking of this study would have been possible without the contribution of several people. It is difficult to single out all those who offered support and encouragement during what at times seemed to be a never-ending journey. However, there are individuals without whom this thesis would not have been completed and to them go my special thanks and acknowledgement for their contribution.

To the Almighty for giving me strength and wisdom to carry out this research.

I would like to first and foremost convey my special thanks to my supervisor, Dr Jayaluxmi Naidoo, for her critical professional guidance, attention and support towards the completion of this study.

Special thanks also go to my husband for his patience, encouragement and support throughout every step of the journey.

I would like to thank my niece Martha Timba for initial editorial work assistance she rendered, specifically in coming up with a contents page.

I would like to express appreciation to my colleagues who contributed to the academic debates that assisted in making up this study, especially Dr Davison Zireva, Christine Thandiwe Moyo and Ronald Manhibi, not forgetting my office colleague, Mrs Siwela Dorcas.

To the assistant researcher who did all the video filming, I say thank you.

I would also like to thank Morgenster Teachers' College administration for granting me permission to go and execute field work leaving behind a lot of work to be done at the station.

Special thanks are also conveyed to the Ministry of Primary and Secondary Education in Zimbabwe for granting permission to carry out the research study in five of the primary schools in Zaka District.

ABBREVIATION

ACARA- Australian Curriculum Assessment Reporting Authority

CASE- Cognitive Acceleration through Science Education

CCTD- California Critical Thinking Disposition Inventory

CPAA-Child Protection and Adoption Act

CRC-Convention on the Right of the Child

CUPM-Committee on the Undergraduate Programme in Mathematics

ECD- Early Childhood Development

ECEC-Early Childhood Education and Care

EFA- Education for All

FET- Further Education Training

ICT-Information and Communication Technology

ILO- International Labour Organisation

ML- Mathematical Literacy

NYSUT- New York State United Teachers

OECD-Organisation for Economic Cooperation and Development

PISA- Programme for International Student Assessment

STEAM-Science, Technology, Engineering, Art and Mathematics

TIMSS- Trends in International Mathematics and Science Study

UK- United Kingdom

UKZN-University of KwaZulu-Natal

UNESCO- United Nations Education Scientific and Cultural Organisation

UNICEF- United Nations International, Children Emergency Fund

UPP- United People's Project

USA-United States of America

ZPD-Zone of Proximal Development

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CHAPTER 1: INTRODUCTION

1.1 Introduction

The study sought to explore the facilitation of critical thinking skills during the teaching of mathematics to promote mathematical literacy in 3-8-year olds in the Zimbabwean context. This chapter introduces the study and includes the background of the study, analysis of the problem, investigation of the problem, the statement of the problem and its research questions. The significance of the study and definitions of terms are also presented. In addition, the key terms used in the study are defined.

1.2 Background to the study

In their daily lives, young learners encounter problems to which they need to find solutions. Whether these problems are large or small, they need to be dealt with wisely. Critical thinking is one of the skills individuals might possess to develop lifelong active learning. (Gibby, 2013). Having the necessary skills to identify solutions to problems is one of the skills that young learners should have from an early age. Young learners must be able to think critically for them to solve problems. Zynglier (2012) argues that when learners develop critical thinking skills, they can solve the social problems they encounter since in problem-solving learners must understand the underlying mathematical feature of a problem. The present study therefore sought to explore the teaching of critical thinking skills to young learners during the teaching of mathematics so promote learner mathematical literacy in the young learners.

Ennis (1991) argues that the ability to think critically is important in whatever we do because it enables learners to think well and solve problems systematically. Thus, the most fundamental reason for teaching critical thinking skills to young learners is because the skills are essential in life. Kibui (2012) noted that critical thinking helps learners to live meaningful life by affording learners the ability to understand and build knowledge without much guidance. It therefore calls that when critical thinking skills are not fostered in young learners, they are most likely to meet several problems in their lives. Ennis (2011) asserts that the incorporation of critical thinking skills in the curriculum for young learners does not only improve effectiveness of lessons but helps the learners to transfer critical thinking into other areas of life. The present study therefore seeks to explore the teaching of critical thinking skills to young learners during the teaching of mathematics

to improve their mathematical literacy. Kibui (2012) is of the view that developing critical thinking skills in young learners requires teachers to use appropriate methodologies in the teaching process.

Brown (2016) grants that many international approaches have been employed in the teaching of mathematics in an attempt to ensure that learners acquire the essential critical thinking skills. This study sought to explore how Zimbabwean teachers teach critical thinking skills to young learners during the teaching of mathematics. Emir (2013) is of the view that a teacher's basic goal in education is to teach critical thinking skills to learners. Critical thinking is one of the 21st skills which teachers must promote during teaching of different subjects since it is among the skills to be developed. However, critical thinking skills are not explicitly taught in Zimbabwe since there is no a specific curricular which mandates the teaching of critical thinking skills to young learners. Leon (2015) admits that the acquisition of critical thinking skills is a life-long process and is developed starting in infancy. Accordingly, critical thinking is not an innate ability, but a learned skill that must be developed, practised and continually integrated into the early childhood curriculum.

Brown (2016) notes that, within the traditional approach, teachers may model ways to solve mathematical problems and learners are not encouraged to think about an alternative process or procedure for solving the problem. Burns (2012) concurs that teachers have traditionally taught mathematics using a set of accepted rules and procedures with an emphasis on obtaining the correct answer. Experience in working with young learners in the Zimbabwean context indicated that, in most cases, learners learnt mathematics by rote memory and a lot of chorusing to provide answers with minimal engagement in critical thinking. On the same note, Balbase (2012) observes that teachers rarely expand learner's critical thinking by asking them to explain their reasoning for their answers to the mathematical problems. The current study therefore sought to explore the extent to which teachers of young learners teach critical thinking to enhance learners' mathematical literacy during the teaching of mathematics.

1.3 What critical thinking incur for young learners

Ennis (1996), a seminal author in the field of critical thinking, believes it to be a reasonable and reflective thinking that is focused on deciding what to believe and do. Accordingly, Paul and Elder (2012) admit that critical thinking is the intellectually disciplined process of actively and skilfully

conceptualising information generated by observation, experience and reasoning. Aizitkovitsh-Udi and Cheng (2015) argue that critical thinking was originally developed during the ancient times during the time of Socrates (740-399) BC. Thus, critical thinking is not a new concept but dates back to the 5thcentury. Critical thinking skills had been taught since then and, as Socrates believed, thinking independently was a learned skill and taught others to think critically (Aizikovitsh-Udi, 2012).

Aizikovitsh-Udi and Cheng (2015) contend that national initiatives around the world, for example, China, Israel, Japan, Singapore and Australia have worked to promote critical thinking skills in learners. Kamarulzaman (2015) conducted a study in Malaysia and established that learners learn to be critical thinkers through experience while they are socialising with other learners. The aforementioned research study also noted that the lack of freedom and direct teaching by teachers of young learners hampers their critical thinking development. This is consistent with the social constructivist epistemology which guides this study. The theory of social constructivism proposes that learners construct knowledge as they play in the environment prepared for them by adults. On the same note, Holmes, Liden and Shin (2013) believe that play has a strong effect on critical thinking, especially when learners are interested in what they are playing.

In view of these sentiments given in the aforementioned studies, critical thinking skills are therefore important to young learners because they enable young them to deal effectively with social, and practical problems. For example, critical thinking skills enhance power relations (Zyngier, 2012). In light of the noted necessity of critical thinking skills in young learners, schools ought to work to equip them with such skills from an early age. Ennis (1991) is of the view that critical thinking is acceptable as an essential element of life since it is a process whereby all scientific processes are considered. Following along similar lines, Kibui (2012) proposed that learner autonomy leads to the development of critical thinking skills by young learners. In teaching young learners, mathematics teachers must attempt to foster critical thinking skills to promote mathematical literacy in the learners by letting them explore with teaching material (Hamby, 2015).

The researcher assumes that young learners can engage in thought processes that may lead to critical thinking. Many practitioners interpret Piaget's stages of development to mean young

learners are incapable of formal operations (abstract reasoning) which are required for critical thinking. However, in an evaluation report on *Philosophy for Children,* Gorard, Siddiqui and See (2015) indicate that young learners engage in many of the cognitive processes that adults do, thus illustrating that there is a place for critical thinking in lower elementary curriculum. Kennedy, Fisher and Ennis (1991) surveyed research literature and concluded that, although critical thinking ability appears to improve with age, young learners may benefit from critical thinking instruction.

Melo (2015) supports the notion that young learners are capable of thinking critically and maintain that critical thinking skills and abilities can be taught. A knowledge gap has been realised because several studies on critical thinking were carried out internationally either with secondary or tertiary students. There is therefore a need for further research in critical thinking with young learners in the Zimbabwean context since the area is not clearly researched. The present study sought to explore the teaching of critical thinking skills during the teaching of mathematics to young learners to enhance mathematical literacy in some of the Zimbabwean primary schools. There also seem to be few studies which focus on actual teaching practices of critical thinking (Wette, 2014). The entire study hence sought to explore the teaching of critical thinking skills to young learners in the Zaka District of Zimbabwe. Attention to the education of young learners has been realised following the recommendations by the 1999 *Presidential commission of inquiry into education and training* commonly known as the Nziramasanga Commission. Before independence, education for young learners in the then Southern Rhodesia, especially those in the 3-6-year age group, was well-defined for white learners only (Shumba & Chireshe, 2013).

The turning point for education for Zimbabwean learners occurred after the 1999 recommendations by the Nziramasanga task force to expand provision for education of young learners in Zimbabwe. The task force had noted a lot of challenges in the education of black young learners in Zimbabwe. The programme for provision of education for young learners by then was known as Early Childhood Education and Care (ECEC). The ECEC programme was under the Ministry of Community Development and Women Affairs. The centres were manned by mothers from the community most of whom had not attained Ordinary level. ECEC teachers in rural areas were paid a stipend by the government usually once a term. The ECEC teachers were trained for service by trainers who also had Ordinary level as their highest qualification. Even though these

ECEC centres were supervised by heads of nearby schools (Nziramasanga, 1999) the issue of quality education for the young learners remained compromised.

In the urban areas, programmes for the education of young learners were privately owned by business owners who usually charged exorbitant fees such that the centres became inaccessible for the majority of the young learners (Principle Director's Circular Number 20 of 2011).Pursuant to the recommendations to expand provision of the education of young learners in Zimbabwe, Director's Circular Number 14 of 2004 was disseminated mandating that learners in the 3-4-year age range (ECD A) and those in the 4-5-year age range be included in the Zimbabwean primary school education system. This was a way to make the education of young learners accessible to all learners since the fees in primary schools were more reasonable than those charged in privately owned pre-schools or nursery schools. Another Director's Circular Number 12 of 2005 was put in place and stipulated that, in public primary schools, early childhood education was made up of ECD A, ECDB and grades one to three. The researcher noted the ever-increasing concerns on the education of young learners and therefore sought to explore the teaching of critical thinking skills to the young learners during the teaching of mathematics to improve their mathematical literacy. Of interest to the present research study is the exploration on the teaching of critical thinking skills to young learners in the 3-8-year age group during the teaching of mathematics in an endeavour to improve their critical thinking skills. The study intends to explore further the education of young learners in primary schools through the teaching of mathematics to establish whether teachers are teaching critical thinking skills to improve the mathematical literacy of their charges.

1.4 Exploring the meaning of mathematical literacy

Turner (2012) believes that mathematical literacy is related to the terms numeracy and quantitative literacy and are used in a variety of ways. The Australian Curriculum Assessment and Reporting Authority (ACARA) (2012) concurs that numeracy involves understanding the role of mathematics in the world and enables the learners to make use of mathematical knowledge purposefully. Furthermore, it should be the right of every child to be able to access quality mathematics education to become mathematically literate (Brewley, 2012). Burns (2012, p. 43) explains that, "The Common Core Standards for Mathematical Practice will require teachers to strengthen learners' numerical reasoning and mental math skills." Mathematically proficient

learners do not only think logically and sequentially but they move beyond the superficial answers that might be expected revealing critical thinking skills.

Firdaus, Wahyudin and Herman (2017) argue that mathematical literacy is about mathematical functions that learners learn at school so as to use them in the global world competition. According to Bullock, Alexander and Gholson (2012),the Young People Project (YPP) formed in Chicago in 2002, for example, aimed at improving the understanding of numbers in elementary school learners through mathematical literacy activities. In Indonesia, the latest 2013 curriculum implemented included expected competencies in mathematical literacy. Mahdiyansyah and Pendidika (2014) concluded that mathematical literacy problems of primary school learners in Indonesia have made some learners to be less capable of applying mathematics in solving problems found in everyday life. Mathematical literacy is important because it enables learners to solve real-life problems related to mathematical concepts (Garfunkel, 2013).The Programme for International Student Assessment (PISA) study noted that mathematical literacy was often included when teaching junior high school and high school students (OECD, 2013). Thus, this research study sought to explore the teaching of critical thinking skills to young learners in the 3-8-year age range. Johar (2012) believes that mathematical literacy should enable the child to resolve problems within or outside mathematical problems in a variety of contexts. Similarly, Suyitno (2012) describes mathematical literacy as the ability of a person (in this case young learners) to use mathematics in various situations. In a research study conducted by Padmavathy and Mareesh (2013), it was revealed that understanding and the ability to use mathematical concepts in real-life is problem-based and part of mathematical literacy.

Experience in working in Zaka District accorded the researcher a number of assumptions concerning the teaching and learning of learners in the 3-8-year age bracket. One of the assumptions was that the teaching of critical thinking skills to young learners was influenced by several factors some of which may facilitate or stifle the development of critical thinking skills in young children. The researcher presupposes that, if learners are not given opportunities to ask questions or reason and solve problems, it means their critical thinking skills could be stifled. Thomas and Lok (2015) submit that the desire to ask questions is an element associated with critical thinking. Learners, especially girls in some ethnic groups in Zaka district where this study was conducted, are socialised not to question or reason with adults. On another note, Ennis (2011)

argues that instruction that supports critical thinking uses questioning techniques that require learners to analyse, synthesise, evaluate information, solve problems and make decisions rather than merely taking a passive role. Empirical research shows that young learners are active and full of energy and merely having information is likely to stifle their thinking. In this regard, passive listening and rote memorisation do not promote critical thinking resulting in the learners developing into poor critical thinkers.

Through experience, the researcher noted that traditional instructional methods in which learners are allowed to parrot answers were being employed in the teaching of mathematics and that may have provided limited thinking on the part of young learners. Based on this premise, there appeared to be a relationship between active learning and critical thinking and a relationship between critical thinking and instructional design. As a result, there might be several issues related to the facilitation of the development of critical thinking to young learners in the 3-8-year age range during mathematics teaching. It is clear that critical thinking is a highly complex topic, and learners' ability to demonstrate criticality is affected by a wide range of factors, not only their cultural background (Bali, 2015). This research study therefore aims to explore issues related to the teaching of critical thinking to promote mathematical literacy through the teaching of mathematics to young learners.

1.5 Context of the study

Experience in working with young learners in Zimbabwe has shown that not all classroom practitioners intentionally engage learners in problem-solving activities and let alone assist them to think critically for them to become mathematically literate. Young learners have the potential to acquire knowledge and heuristic teaching methods are likely to encourage learners to learn. The learners should be exposed to situations in which they discover experiment, evaluate and find possible solutions to problems. It has been noted that some practitioners just provide activities for young learners without considering whether these activities enhance problem-solving skills. The kind of activities provided for learners need to focus on how to solve problems in a variety of ways that tickle their thinking, one of which is through trial and error.

This research study seeks to establish factors that influence critical thinking skills in young learners and the extent to which teachers of young learners intentionally make use of activities in

mathematics teaching that enhance critical thinking skills and development of mathematical literacy in young learners. The assumption was that the processes of learning and development of young learners are influenced by how they are taught by practitioners. The study was carried out in the Zaka District which is in Masvingo Province of Zimbabwe. Schools in the district vary in terms of standards expected of early childhood development. Most schools do not have qualified early childhood teachers. However, they are trickling in as they graduate from teachers' colleges. With the establishment of early childhood development in schools, some communities are beginning to realise the importance of this department in schools.

1.6 Statement of the problem

The majority of practitioners who work with young learners seem not to intentionally instil critical thinking skills in young learners during their mathematics teaching. It is not clear whether teachers of young learners effectively teach them to think critically in a variety of situations. Knowing that learners should be taught to think critically is not the same as being able to instil critical thinking skills in young learners during teaching and learning situations. As a result, this study aims to explore the teaching of critical thinking skills to young learners in the 3-8-year age range during mathematics lessons to promote mathematical literacy in the learners.

1.7 Research questions

1. What factors are related to the teaching of critical thinking skills to young learners?
2. How are critical thinking skills taught to young learners?
3. Why is there a need to teach critical thinking skills to young learners?

1.8 Significance of the study

It is envisaged that the present study will benefit policy makers, heads, early childhood development (ECD) teachers, parents and ECD learners, among other early childhood education stakeholders, individuals and institutions in the Ministry of Education Sport and Culture and Ministry of Higher Education Science and Technology Development in Zimbabwe and elsewhere.

ECD stakeholders such as school inspectors, heads and policy makers will be afforded a criterion to monitor, supervise and evaluate effective teaching of critical thinking skills with young learners in Zimbabwe and elsewhere. ECD stakeholders will also get valuable information required for provision of quality ECD programmes and get informed on how, when and why such services

should be provided. It is expected that such information would enhance effective teaching of young learners and efficiency in programmes for young learners in Zimbabwe since there is not much that has been done in their education. Learners in the foundation phase are also anticipated to benefit from increased knowledge of how they could acquire critical thinking skills during mathematics lessons.

Pedagogies regarding learners in Zimbabwean ECD programmes will be catered for from an early age by seeing, hearing and listening to the voices of learners and or teachers in the current research study. It is hoped that challenges experienced in providing quality delivery of mathematics lessons in ECD programmes will be circumvented thereof. The research study is aimed at exploring the teaching of critical thinking skills, not only to improve mathematical literacy, but to enhance critical thinking skills across the ECD curriculum thereafter.

The current study will also provide other researchers with data and information that could be useful in the provision of quality education in early childhood development in Zimbabwe. It is anticipated that this study will fill a void in the research base of critical thinking skills in early childhood education in Zimbabwe due to the absence of published researches on critical thinking with young learners. Much of the literature on critical thinking and mathematical literacy is from the United Kingdom (UK), United States of America (USA), Australia and Sweden, among others. The results from the present research study hopes to ultimately influence policy and legislation with respect to critical thinking skills in teaching mathematics to young learners. Finally, it is anticipated that the research study will add to the limited literature base on the education of young learners in Zimbabwe, specifically focusing on critical thinking and mathematical literacy.

1.9 Rationale for the study

Several factors have prompted the execution of the current study. The researcher has been thrilled by the area under study because she has passion in the education of young learners and is a specialist in early childhood development. This interest arose because the researcher has been teaching young learners and has been supervising ECD students on teaching practice for a good number of years, where she raised a lot of unanswered questions in the teaching of critical thinking skills during mathematics lessons by teachers in the foundation phase (ECD). The researcher sought to explore the teaching of critical thinking skills in mathematical literacy with young learners in a sample of only five Zimbabwean primary schools in Zaka District.

The research study was undertaken because of the conviction that critical thinking skills are important to young learners as they enable them to analyse, synthesise and evaluate information to solve problems and make decisions than merely repeating information (memorisation). The study sought to explore the teaching of critical thinking skills to improve mathematical literacy with young learners and thus improve service provision for Zimbabwean ECD programmes and other national programmes for young learners thereafter.

An exploration into the teaching of critical thinking skills to improve mathematical literacy of young learners ought to reveal insights in the required or necessary teacher competences to come up with the most effective ways of enhancing teaching such skills. Quality provision of ECD services can mould young learners to deal effectively with social, scientific and practical problems. The researcher felt compelled to explore the teaching of critical thinking skills to promote mathematical literacy of young learners in five Zimbabwean schools in Zaka District. This will result in a relevant model for teaching critical thinking skills to young learners in a Zimbabwean context and elsewhere.

Critical thinking skills are important to young learners because they enable them to deal effectively with social, scientific and practical challenges. To support this premise, focused attention ought to be placed on the application of content, the process of learning and methods of teaching young learners critical thinking. Critical thinking is a mental habit that requires learners to think about their thinking and about improving the process and this requires learners to use higher order thinking skills not just to memorize data or accept what they read or what they are told without critically thinking about it. Merely having knowledge or information is not enough if young learners are to become critical thinkers; but to use the knowledge in different life situations.

To link critical thinking skills to mathematical literacy, the instructional focus should be on the process of teaching and how learners get to acquire the information and skills. Traditional instructional methods use too many facts and not enough conceptualisation, too much memorising and not enough thinking. Passive listening and rote memorisation may thus not promote critical thinking resulting in poor mathematical literacy and poor problem-solving skills. It is hoped that findings of the present study are going to influence a positive curriculum change in early childhood development in Zimbabwe and elsewhere.

1.10 Definition of terms

1.10.1 Critical thinking skills

Critical thinking is an important element of mathematical literacy necessary for justifying one's mathematical reasoning (Aubrey, Ghent, & Kanira 2012).According to Ennis (1989), someone with critical thinking skills is able to think out of the box while pursuing less popular approaches. He further emphasised that critical thinking should not be confused with being argumentative or being critical of other people.

Despite differences in definitions of critical thinking given by different schools of thought, the concept critical thinking skills in the current research study converges on the child's ability to analyse evidence, making inferences, solve problems, give valid reasons, make sound decisions, distinguish, interpret, define solutions, draw conclusions, synthesise, think independently, recognise problems, ask questions and evaluate, among other competencies.

1.10.2 Mathematical literacy

The PISA (2015, p.5) study defines mathematical literacy as "an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make well founded judgments and decisions needed by constructive, engaged and reflective citizens." In this research study, mathematical literacy has to do with a learner's ability to apply mathematical knowledge, skills and understanding in real-life contexts. It has to do with learners using mathematics in a variety of situations. In other words, through mathematical literacy, learners make their mathematical knowledge functional by applying it to the real world.

1.10.3 Young learners

According to the Convention of the Right of the Child (CRC) of 1989, a child is any one below the age of eighteen or below the age of majority. Additionally, the Child Protection and Adoption Act (CPAA) describe a child as any person under the age of sixteen. In the current research study young learners refer to learners in the 3-8-age bracket. In the Zimbabwean context learners in this age bracket are found in ECD "A" 3-4-year olds, ECD "B" 4-5-year olds classes as well as in the infant grades 5-8-year olds found in Grades1 and 2.

1.10.4 Resources

Stimuli inform of materials or tools used within the school environment for effective teaching of mathematics to young learners (Carmichael & Farrell, 2012).This can be print rich or visually rich stimulating mathematical environment that is made an integral part of mathematics teaching for young learners to explore and acquire mathematical knowledge.

1.11 Conclusion

The present chapter provides an introduction to the study, placing the study within a context by looking at the background of the study, context of the study, statement of the problem, aims of the study, research questions, significance of the study, rationale for the study and definition of terms. The subsequent chapter reviews literature related to the teaching of critical thinking skills to promote mathematical literacy. The exploration is undertaken so as to establish the extent to which teachers in Zimbabwe are stimulating critical thinking skills in young learners to promote mathematical literacy when they are teaching mathematics.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The current chapter reviews literature related to the teaching of critical thinking skills to young learners. The literature is structured under different subheadings driven from the study's research questions. International and national literature is reviewed on factors influencing the teaching of critical thinking skills, how critical thinking skills are taught in different perspectives as well as on the benefits of teaching critical thinking skills to the young learner. Gaps that need to be filled in during the research study were exposed during the review.

2.2 Contextualising critical thinking skills

Davies (2016) submits that if we do not have a clear idea of what critical thinking is, we cannot teach it. Wang and Zheng (2016), in their Chinese research study, maintain that critical thinking is the kind of thinking involved in solving problems, formulating inferences, estimating, and making decisions. Lau and Chan (2017) view critical thinking as the ability to think clearly and rationally about what to do or what to believe. Brookfield (2012) acknowledges that critical thinking is not inborn, but a learned skill that must be developed, practised and continually integrated into the early childhood curriculum.

Ennis (1991), a seminal author in the field of critical thinking, views critical thinking as reasonable, reflective thinking that is focused on deciding what to believe and do. For young learners, critical thinking can be explained in relation to the following characteristics: categorising, making comparisons, sequencing, focusing attention, exploring numbers, space and time, making decisions solving problems and detecting cause and effect. In this context critical thinking may be referred to as an active way of thinking in which young learners effectively utilise the acquired knowledge in practical experiences. Active thinking by young learners during the teaching of mathematics enables them to effectively make use of acquired mathematical knowledge to day to day use (mathematical literacy). From an empirical point of view, critical thinking is whereby young learners are culturally liberated to think actively in any given situation. Young learners therefore need to be assisted to think critically from an early age by factoring in the skills necessary for promoting critical thinking skills in their activities. The aforementioned Chinese study by Wang and Zheng (2016) argues that there is no denying the fact that critical thinking is hard to

teach as discrete parts of a subject because it is not easy to foster in a typical classroom environment.

Many skills, including critical thinking, may develop through time and experience. If a strong foundation is built, young learners are most likely to become critical thinkers. Goulani (2014), in a research study conducted in the Middle East at the University of Kurdistan-Hewler, noted that critical thinking is a complex term defined in numerous ways and valued in many academic institutions. The teaching of critical thinking skills is a process which cannot be done overnight but needs a purposeful instruction that helps the young learners acquire the skills (Brookfield, 2012). Thus, if thinking is a learnable skill then questions arise concerning how best to improve performance of the young learners and ensure that what is learned is generalisable to new contexts. Thyer (2013) asserts that critical thinking can be taught by breaking down the process of thinking as a number of steps where the teacher should take the role of a facilitator instead of an instructor. Based on the aforementioned views critical thinking can be gradually taught to the young learners from an early age.

Davies (2016) avers that some people resist critical thinking because they believe it is the same as criticism of others, or criticism of oneself. The present research study has therefore explored issues related to the teaching of critical thinking to improve mathematical literacy in young learners. Critical thinking is further described as an active process that involves the continuous questioning of right and wrong and does not necessarily bring one to an ultimate answer or conclusion (Brookfield, 2012). Based on the given sentiments, critical thinking is therefore quite compatible with reading between the lines, reading beyond the lines or thinking outside the box. It is therefore important to equip young learners with critical thinking skills from an early age for them to use it in their day to day living (in this case, mathematical literacy).

The debate on critical thinking indicates that there are many perceptions and assumptions that are prevalent among educators concerning critical thinking and the young learners. The question of whether or not age differences extend to reasoning patterns and critical thinking abilities remains unsolved. Empirical research suggests that people begin developing critical thinking competences at a young age. For example, a research study conducted by Stocks, April and Lynton (2012) in South Africa tested hypothesis that the critical thinking dispositions of 1st grade learners would

be significantly lower than those of the 4th grade learners. The results indicated that the arithmetic means of critical thinking dispositions of senior learners were significantly higher when compared to 1st grade learners.

The academic debate on development of critical thinking skills in young learners indicate that more research needs to be done in early childhood development where very few people in Zimbabwe have done research concerning the education of learners especially in the 3-8-year age bracket. There is a knowledge gap because very few studies on critical thinking were carried out in this area. For example, a research by Zireva (2011) on factors that stifle critical thinking dispositions of the third-year students at Morgenster Teacher's College was carried out at tertiary level. The researcher therefore saw the need for conducting a research at ECD level to explore the teaching of critical thinking skills to young learners in a bid to promote their mathematical literacy.

The pragmatists, who believe in learning by doing, are of the view that young learners best learn through experience or hands on activities and thus placing the importance of learning resources in the teaching of the 3-8-year olds. Beilock (2015),in a research study conducted in Chicago, established that learning by doing gives meaning to the idea of learning because, by experiencing mathematics physically, learners are more likely to activate sensory and motor areas. Based on the preceding views and the social constructivist epistemology, the only way in which teachers of young learners are likely to develop their critical thinking is to make them active in their own learning and give them the opportunity to interact amongst themselves and or with learning resources. Debate still exists concerning how to include critical thinking into the curriculum for young learners, and what strategies to be used to enhance critical thinking skills. Australian Curriculum Assessment and Reporting Authority (ACARA) (2013) and Mumford, Medeiros and Parthow (2012) confirm that critical and creative thinking are skills to be applied across the curriculum and beyond the classroom.

2.3 Contextualising mathematical literacy

Turner (2012) noted that the use of the term mathematical literacy appears to be newer, but dates back to at least the late 1970s. The original definition given by the Programme for International Student Association (PISA) is that mathematical literacy refers to an individual's capacity to identify and understand the role mathematics plays in the world, to make well founded

mathematical judgments and to engage in mathematics in ways that meet the need of that individual's current and future life. Blake (2015, p.21) outlines the following areas that a child ought to possess to have mathematical literacy:

- Mathematical thinking and reasoning: Being able to ask and answer math-related questions;
- Mathematical argument: Understand proofs, chains of arguments, heuristics and creating and expressing mathematical arguments;
- Mathematical communication: The ability to understand and express mathematical knowledge;
- Modelling: Translate mathematical concepts into physical forms and reflect upon, analyse and critique models;
- Problem posing and solving: The ability to create and solve mathematical problems;
- Representation: Decoding, encoding, interpreting, distinguishing between and translating different mathematical concepts;
- Symbols: Understand and use mathematical language;
- Tools and technology: The ability to use math-related tools and technology.

In the context of young learners in Zimbabwe, mathematical literacy may refer to the ability of young learners to use critical thinking skills in the application of acquired mathematical concepts. Mathematically literate young learners should critically engage their acquired mathematical knowledge to everyday use or solve real problems. In showcasing mathematical literacy, young learners are expected to make use of stimulating mathematical learning resources including technological ones. Young learners ought to be equipped with mathematical skills that they will make use of in their future to understand the world.

There is tension between the intended meanings of words in which people commonly use. For example, the word numeracy in Australia is commonly used but also with different meanings in different places. Other countries have already worked in the area of mathematical literacy. In Japan, about seventy scientists and educators took part in a study conducted from 2005 to 2006 to examine the current states of scientific, mathematical and technological literacy (Nagasaki, 2012). Drawing from Nagasaki's standpoint other countries such as the USA, Canada, England and China joined the study to establish the significance and necessity of literacy as well as organisational

systems for developing mathematical literacy. However, the work done in other countries concerning mathematical literacy does not display work done in teaching critical thinking skills to improve mathematical literacy with young learners and cannot be generalised to the Zimbabwean situation. There is therefore a need to explore the teaching of critical thinking skills in the Zimbabwean context so as to improve mathematical literacy in young learners thereafter.

Botha (2012) maintains that South Africa is the first country in the world to have mathematical literacy (ML) as a school subject. The subject was introduced in 2006 as an alternative to mathematics in the Further Education Training band (FET). Basing on Botha's viewpoint, the purpose of this subject is not only to provide learners with an awareness and understanding of the role that mathematics plays in the modern world, but also with the opportunity to engage in real-life problems in different contexts. Even though mathematical literacy is not taken as a subject in Zimbabwe, there is a need to explore critical thinking skills of young learners because mathematical literacy is likely to be enhanced by giving learners opportunity to think critically in solving real-life contextual problems(Larson,2013).

A study research conducted in Indonesia by Padmavathy and Mareesh (2013) established that mathematical literacy is driven by life-related applications of mathematics and enables learners to develop the ability to think numerically, in addition to critically analyse everyday situations and solve problems. Learners ought to apply mathematical knowledge to their daily lives for them to properly function in the modern world because mathematics is important in every person's life as it aids problem-solving. The researcher presupposes that critical thinking skills enhance mathematical literacy which also contributes to the learner's ability to function effectively in society. Garfunkel (2013) believes that mathematical literacy is important because it enables learners to solve real-life problems related to mathematical concepts. Furthermore, Tai, Leou and Hung (2014) are of the view that mathematical literacy is the ability of learners to apply mathematics in various contexts, including the ability to reason mathematically. Without mathematical literacy, learners may not be able to apply the mathematics they learn at school into real-life situations.

According to Botha (2012), a study of the Education Department of Queensland provided an insight into the role numeracy plays in the education system of Australia. Botha (2012) further

emphasises that there are numerous documents and guidelines available to teachers on how to develop numeracy skills of learners in mathematics classrooms in Australia. This background shows that some countries have gone a long way in enhancing quality in mathematics education. In this study, the researcher sought to explore the teaching of critical thinking skills to improve mathematical literacy of young learners in a bid to establish the extent to which the Zimbabwean teachers teach critical thinking skills during mathematics lessons. Clark (2012) admits that mathematical literacy enables learners to think numerically and spatially in order to interpret and critically analyse everyday situations and to solve problems. Terry (2010) believes that there is a growing community of educators and researchers who have taken responsibility for re-shaping how we understand mathematical literacy, but it is also true that literacy instruction does not need to occur in a social, cultural and political vacuum. Based on the social constructivist epistemology, mathematical literacy always operates within a context (Vygotsky, 1978). The researcher, therefore, maintains that these entire findings and academic debates have to be verified through exploring the teaching of critical thinking skills to improve mathematical literacy in learners in the 3-8-year age range.

2.4 The relationship between critical thinking and mathematical literacy

Aubrey, Ghent and Kanira (2012) submit that there is a relationship between critical thinking and mathematical literacy because critical thinking is believed to be an important element of mathematical literacy necessary for justifying one's mathematical reasoning. Brown (2016) believes that mathematical literacy is driven by life-related applications of mathematics which enable learners to develop the ability and confidence to think numerically in order to interpret and critically analyse everyday situations and solve problems. Firdaus and Baker (2015) admit that critical thinking can be developed through a process of mathematics learning because the mathematics has a strong and clear connectivity between its concepts to learners who learn mathematics. From the given sentiments, there appears to be a strong link between the development of critical thinking skills in young learners and the promotion of mathematical literacy. Learners who acquire critical thinking skills during the teaching of mathematics are likely to make use of use the skills in real mathematical contexts. According to Burns (2012), teachers have traditionally taught mathematics basing on prescribed ways with an emphasis on obtaining the correct answer. Additionally, Oguntoyinbo (2012) avers that the traditional mathematics pedagogy does not encourage learners to reflect on their thinking nor does it encourage the learners

to be active participants in their own learning during the mathematics lesson. The current research study sought to explore how teachers are teaching young learners critical thinking skills to improve their mathematical literacy. Dickey (2013) admits that critical thinking skills can be enhanced in young learners if only educators move away from rote learning and create situations where learners get an opportunity to think about the processes they use to solve a mathematical problem and then justify their answers.

Brown (2016) asserts that mathematical literacy is anchored in ideas relating to quantitative skills needed for adult life, including the need for active citizenship. It is imperative to have critical thinking skills for a person to be mathematically literate because application of critical thinking skills to practical problems within disciplines contributes to the lifelong pursuit of knowledge and the capacity to solve future problems (Fortino, 2015). Similarly, Aubrey, Ghent and Kanira (2012) maintain that proficiency in critical thinking is essential to lifelong learning and to deal effectively with challenges in society. Based on the sentiments noted previously, critical thinking never considers anything in a vacuum, but has source or context in which it is situated, and thus critical thinking has a relationship with mathematical literacy.

Literature on critical thinking and mathematical learning seem to be scant. In a research paper, Shek (2018) mainly focuses on English language learning in Singapore, and indicates that constructivist approaches to teaching young learners critical thinking are necessary for they can be infused successfully into instruction for young learners. Shek (2018) further cites Langrehr (1999) who proposes teaching thinking for young learners as starting with thinking skills to improve mental organisation. The proposed skills for mental organisation are listed subsequently:

Improving mental organisation (Extracted from Langrehr, 1999) as cited by Shek (2018).

1) Observing properties
2) Observing similarities
3) Observing differences
4) Categorising similar things
5) Identifying differences
6) Comparing
7) Sorting Things into Groups

8) Organising Things in Order of Size
9) Organising Things in Order of Tim
10) Generalising about Examples

The proposed activities, though focused on English language lessons, seem to be useful in enhancing critical thinking skills during mathematics teaching so as to promote mathematical literacy. This could be linked to critical thinking to promote mathematical literacy since the young learners organise information through more complex thinking processes.

2.5 Factors related to the teaching of young learners critical thinking skills

Experience has shown that a number of factors are related to the teaching and acquisition of critical thinking skills in young learners. Some factors that are assumed to have an influence on critical thinking skills include age, culture, gender and background of learners. All these factors are likely to have an influence on how teachers facilitate the development critical thinking skills to young learners during mathematics teaching. It was not until the publication of the California Critical Thinking Disposition Inventory (CCTDI) in 1992 that researchers had a valid and reliable measure by which to profile a person's critical thinking habits of mind. Literature has been reviewed on these factors in relation to the teaching of critical thinking skills to young learners. The emphasis here is to prepare learners for the future in unpredictable world and they need to gain skills which will give them greatest control over their lives and learning. For this reason, young learners must be assisted to think critically, creatively and imaginatively at the highest possible level during the teaching of mathematics.

In a research study carried out in Sweden, Bjorklund and Barendregt (2015) wanted to find out the status of pedagogical mathematical awareness of Swedish early childhood teachers. One hundred and forty-seven (147) teachers were asked to respond to their habits of working with mathematics. Results of the study showed limitations on the part of the teacher's delivery of content revealing that there was a need for further stimulation of teacher training. The teachers ought to have skills to assist learners to think critically and therefore they should have critical thinking skills themselves for learners to emulate. Based on social constructivism, young learners learn from other people through social interaction. Aizikovitsh-Udi and Cheng (2015) argue that both training and knowledge on the part of the teacher are necessary to promote critical thinking skills and abilities

in young learners, one of which is the ability to use mathematics in real-life situation (mathematical literacy). The present research study is therefore meant to explore the teaching of critical thinking skills to young learners to improve their mathematical literacy.

The exploration on the teaching of critical thinking skills to young learners is done as a way to identify some areas that might need further stimulation in early childhood mathematics education. Sweden has recently introduced a revised curriculum for early childhood education (learners aged 1-5) presumably with expectations to improve learners' early numerical development by focusing teacher's attention on mathematics as content and goal for learning (Bjorklund & Barendregt, (2015). It was therefore seen as a necessity to carry out the present research study because literature on Zimbabwe does not reveal any efforts made to improve the teaching of critical thinking skills to young learners, right across the ECD curriculum.

A questionnaire was used as the basis for the overview of the research study carried out in Sweden. The current research study however used observation, interviews and analysis of videos to generate data. The Swedish curricular further emphasised the need for learners to be given opportunities to explore, use and reason about mathematical concepts and relationships (Bjorklund & Barendregt, 2015). It is therefore hoped that if such a need is emphasised in early childhood development (ECD) mathematics curricular in Zimbabwe, development of critical thinking skills would be enhanced in young learners and may result in improvement in their mathematical literacy. Critical thinking thus deserves some priority as a curriculum aim for all young learners. It is against this background that the researcher sought to carry out a research study in the area of critical thinking skills for young learners because the early childhood development curriculum in Zimbabwe does not explicitly display the need for learners to think critically.

Recently, the early childhood programme in Zimbabwe has taken a turning point by attaching pre-academic classes to primary schools as per the Director's Circular Number 14 of 2004 and Circular Minute Number 12 of 2005, where each primary school was mandated to attach ECD 'A' and 'B' classes with learners in the 3-5-year age bracket in phases. The recommendations made after this review also compelled the researcher to carry out this research study because it indicates that further research is necessary to define precisely some of the thinking skills, especially those associated with young learners. The researcher thus took heed of this recommendation by

exploring the teaching of critical thinking skills to young learners to improve mathematical literacy. This is because the way in which a learner acquires critical thinking skills and the possibility of improving its effectiveness have a potential for classroom practice and research. The review of literature indicates that the theories of thinking and critical thinking, especially about young learners in the Zimbabwean context, are incomplete and hence the need to explore the teaching of critical thinking skills to improve mathematical literacy.

2.5.1 The relationship between age and the development of critical thinking skills

Empirical research suggests that people begin developing critical thinking competences at a very young age. In a small-scale research study conducted in Ireland, Dwyer (2017) noted that mature learners think they are pretty good in critical thinking and are often overconfident in their ability to think critically. However, there are caveats to this assertion since the research study indicated that though mature learners report approximately the same level of disposition towards thinking, their ability to apply critical thinking before intervention of critical thinking training does not match younger learners' ability. The conclusion for the study was that, with adequate training in critical thinking, ability to think improves over time and it is never too late for teachers to consider teaching critical thinking. The present research study is thus a necessity as it explores the teaching of critical thinking skills to young learners in early childhood development grades, especially in Zimbabwe where very few scholars have done research concerning the education of learners in the 3- 8-year age bracket.

There is a knowledge gap on critical thinking in the Zimbabwean literature except for a study that was carried out by Zireva (2011) on factors stifling critical thinking dispositions of college students. There is a need therefore for further research on critical thinking in young learners since the area is not clearly supported. Schunk (2012) believes that critical thinking is a learned skill that requires instruction and practice. He maintains that critical thinking skills can be enhanced by using instructional strategies that actively engage learners in the learning process rather than relying on lecture and rote memorisation. The pragmatists who believe in active participation by young learners assert that young learners acquire concepts better through experiential learning. This means young learners have to experience mathematics for them to gain critical thinking skills and improve in mathematical literacy.

According to Afsahi and Afghari (2017), critical thinking is an everyday activity and whenever people, even young learners, want to make decisions, they go through the thinking process. Critical thinking has thus become a central issue in the educational process and hence the necessity to explore the term in teaching. More recent research has found that young learners engage in many of the same cognitive processes that adults do, indicating that there is a place for critical thinking in the early childhood curriculum. Zyngier (2012) acknowledges that there is no single age when learners are developmentally ready to learn more complex ways of thinking. Empirical research supports the notion that young learners are capable of thinking critically and maintain that critical thinking skills and abilities can be taught.

Gibby (2013) mentions that there is evidence across the world that young learners meet problem situations in their adult lives for which there are no ready-made formulas or procedures to provide solutions. There is a need therefore to mathematically empower young learners through promoting their critical thinking to improve mathematical literacy. Being critically oriented is thus the means by which young learners can be prepared for their day to day living as well as preparing them for adult life. According to Freeman (2012), active learning can make the work more enjoyable for both teachers and learners and, most importantly, it can cause learners to think critically. Schoenfeld (2017) avers that mathematics has been described as an empowering tool by which people can learn to reason and make sense of the world around them. Young learners ought to be active participants in mathematical sense-making during the teaching of mathematics. The ability to function effectively in society can only be enhanced in learners through fostering critical thinking skills to promote mathematical literacy.

2.5.2 The relationship between gender and the development of critical thinking skills

French (2013) declares that almost one in five of all Irish fifteen-year olds and almost one in four teenage boys lacked literacy skills to adequately function in today's society. In addition, one in five Irish teenagers did not have sufficient numerical skills to cope with everyday life. An Iranian research study conducted by Salahshoor and Rafiee (2016) to investigate the relationship between critical thinking and gender among Iranian learners revealed that males and females were not significantly different from one another in terms of applying critical thinking skills. The aforementioned research study had attempted to trace the difference between male and female learners in applying critical thinking. The tracing was done by completing a validated Persian

version of Watson Glaser's Critical Thinking Appraisal which consisted of 80 items which were supposed to be completed in 45 minutes. The finding of the research study revealed poor critical thinking skills among learners regardless of gender. It was in light of these statistics that the present research study sought to establish whether there are marked differences in critical thinking skills between young boys and girls in Zimbabwe. This study solicited information from teachers as well as observation of learners during mathematics lessons and activities.

Gender, as a predictor of critical thinking skills, has such conflicting results as a variable that has been evaluated by nearly all of the critical thinking research studies (Hasheni & Ghanizadeh, 2012). In an Iranian research study, Aliakibari and Sadeghdaghighi (2012) examined the extent to which Iranian students in Ilam University are critical thinkers. In the aforementioned study, the effects of gender on the development of critical thinking skills were supported. In addition, Gadi, Baker, Alwi and Talib (2012) conducted a research study in Malaysia and found out that there was no significant difference between male and female in the level of critical thinking skills, indicating a null effect of gender on critical thinking. In another research study conducted in Indonesia, Zetriuslita, Ariawan and Nufus (2016) found out that the level of capacity for both male and female learners are similar in the ability to justify and analyse the concept of algorithms. The conflicting results of critical thinking skills with respect to gender and development gave the researcher the impetus to explore the teaching of critical thinking skills to young learners in the Zimbabwean context. The focus was also on how gender influences the development of critical thinking skills in young learners during the teaching of mathematics.

2.5.3 The relationship between critical thinking and culture

Guo (2013) views culture as an abstract term that defines a broad range of activities in which individuals express themselves, and it is important because it tells us in different degrees what we are expected to think, say and behave in typical life situations. According to Hurst, Wallace and Nixon (2016), learning involves building knowledge on the contextual background that the learner brings to the classroom. Based on the given sentiments, some cultures may not afford learners the opportunity to think critically. In fact, some Chinese cultural dimensions have been seen as barriers to the development of critical thinking. Guo (2013) contends that in China, where learners grow up engaged with passive learning, cultivating critical thinking is one of the most difficult tasks

during teaching. The present research study sought to find out whether culture influences the development of critical thinking skills in young learners in the Zimbabwean context.

The method of teaching critical thinking skills requires learners to engage in independent thinking such as coming up with options, problem-solving, analysing and evaluating information. In a research study conducted in Nigeria, Aboluwodi (2016) confirmed that most teachers are still slaves of the colonial education tradition where the focus was to teach learners for examination. Additionally, due to differences in origin and development in cultural systems, Chinese and Western cultures display different cultural traits that attribute to the differences in their thinking dispositions. In the present research study, the focus was on how culture is related to the teaching of critical thinking skills to improve mathematical literacy. This was done with both teachers and young learners to find out the relationship between culture and the development of critical thinking skills since culture may influence how people think and solve problems. According to Miu-Chi (2012), New Zealand European learners were found to perform better than their Asian counterparts on an objective measure of critical thing. The overall conclusion indicated that culture has an important influence on learners' practice of critical thinking. The present research study provided empirical evidence on how culture influences the teaching of critical thinking skills to young learners. Miu-Chi (2012) reasons that the influence of culture does not necessarily impede the application of critical thinking instruction in multicultural classes, but critical thinking instruction may be beneficial to the intellectual development of learners regardless of their cultural backgrounds.

Guo (2013) submits that in Chinese collectivistic culture, harmony and cooperation among the group tend to be emphasised more than individual achievement or freedom. The development of critical thinking skills may be stifled because compliance with norms inhibits individual beliefs which are needed in critical thinking skills. Based on Guo's standpoint, submissiveness and the maintenance of pleasant social relations are valued more, and learners tend to be more active when interacting and sharing idea amongst themselves. These cultural dimensions may thus have a great impact on the thinking dispositions in a variety of ways that may also become barriers to the development of good critical thinking skills. It is therefore likely that culture-based instructions may explicitly and systematically prepare young learners with knowledge, skills and attitudes necessary for their development as critical thinkers.

Drawing from the aforementioned views on Chinese and Nigerian cultural traits, culture has proven to be related to the development of critical thinking skills in young learners. Actually, people from different cultures abstract whatever fits into their personal world of recognition and then interpret it through the frame of reference of their own culture (Aboluwodi, 2016). Health (2012) admits that people from cultures different from others might find clues they could use in their own processes of critical thinking. This research study therefore aimed at establishing whether the teaching of critical thinking skills to early childhood learners in the 3-8-year age range in Zimbabwe is influenced by their cultural backgrounds. The researcher was obliged to explore the teaching of critical thinking skills to improve mathematical literacy in young learners because every young person is expected to understand and use mathematics in their daily lives (mathematical literacy). Mathematical literacy is important because it can facilitate learners in solving real-life problems related to mathematical concepts (Garfunkel, 2013). Furthermore, Suyitno (2013) views mathematical literacy as the ability of a person (in this case, young learners) to formulate, implement, and interpret mathematics in various contexts, including the ability to perform reasoning mathematically. Culture has therefore an influence on the teaching of critical thinking skills which, in turn, may result in the improvement in mathematical literacy in young learners.

2.6 The teaching of critical thinking skills in the Zimbabwean context in relation to other countries

2.6.1 Lack of suitably qualified teachers of young learners

Zimbabwe, as a signatory to the Education for All, has worked to improve the education of young learners. However, International Labour Organisation ILO (2012) has noted that several factors have influenced the education of young learners in developing countries including Zimbabwe. In an effort to meet goal number one of the United Nations millennium goals (in which member states were compelled to expand and promote comprehensive early childhood programmes, especially for the most vulnerable and disadvantaged learners), several countries have worked to improve the education of young learners. The early childhood education programme plays an important role in improving the education of learners, in this case, learners' critical thinking skills may be developed, and their mathematical literacy improved in turn.

The Aga Khan Foundation (2013) indicates that teacher facilitators who receive stable, higher monthly wages tend to demonstrate higher quality teaching than those who receive lower salaries. In light of the aforementioned view, the education of young learners in Zimbabwe was likely to be compromised since the early childhood education and care (ECEC) teachers were only receiving stipend usually once a term. In their paper commissioned for the EFA Global Monitoring Report, Sun, Rao and Pearson (2015) revealed that early childhood programmes have had problems in recruiting and retaining good teachers, and this adversely impacted on the quality of early learning programmes. Zimbabwe, just like any other developing country, employed unqualified personnel from the community while developed countries like Sweden, New Zealand and Australia required at least a three-year bachelor's degree for lead teachers in early childhood education programmes (ILO, 2012). The qualifications of the ECEC teachers in Zimbabwean in the 1990s was likely to compromise the education of young learners since the training of specialist ECD teachers only stated after the recommendations of the *Presidential Commission of Inquiry into Education and Training*(also known as the Nziramasanga Commission) in 1999. Based on the recommendations by the Nziramasanga Commission report, specialist ECD teachers are now deployed in schools as they graduate from teachers training colleges. Before that, as previously observed, the education of young learners in Zimbabwe seemed to be lagging behind because of shortage of suitably qualified teachers who underpinned sound teaching practices.

2.6.2 Lower standards of education for young learners in rural areas

In a paper commissioned for the EFA Global Monitoring report, Sun, Rao and Pearson (2015) indicated that young learners in rural areas of developing countries are usually disadvantaged in terms of early education as compared to their urban counterparts. The aforementioned report indicates that there are some disparities between urban and rural areas in terms of provision of quality education for young learners. This research study therefore sought to explore the teaching of critical thinking skills to young learners in rural primary schools to establish the extent to which teachers facilitate the development of critical thinking skills in young learners during the teaching of mathematics.

A study conducted in the OECD countries showed that the number of qualified early childhood educators is limited in rural areas (Munoz, 2012). In China, 61% of learners under six years live in rural areas and efforts are now made to increase the services in rural areas (Rao et al.,

2012).Against this background, the focus in the present research study has been extended to explore the teaching of critical thinking skills to young learners in rural schools in Zaka District of Zimbabwe. This was done to find out the extent to which young learners are benefiting from instruction now that several specialist ECD teachers are teaching in rural schools. According to the latest report of the ILO, around ten million learners have benefited under the three-year Action Plan by increasing teacher supply in rural areas (ILO, 2012).

Kramer (2014) maintains that there is a high level of concern with regard to provision of better education for young learners in rural settings in Brazil despite considerable efforts by the government to come up with policies in favour of their education. Zimbabwe has put in place policies such as Director's Circular number 14 0f 2004, Director's Circular Number 12 of 2005 as well as Statutory Instrument 106 of 2005 in a bid to improve the education of young learners. Following the Zimbabwean government's effort to improve the education of young learners, this research study therefore sought to explore the teaching of critical thinking skills to young learners so as to ascertain how they acquire such skills during the teaching of mathematics.

2.7 Enhancing the development of critical thinking skills in young learners

In a Columbian baseline research study, Melo (2015) revealed that resources frequently used in teaching such as auditory, visual, concrete and manipulative are important in activities planned by teachers but there is no evidence that these kinds of resources are specifically designed to help learners develop critical thinking skills. Facilitation of the development of critical thinking skills might be based on different issues. Shen (2012) is of the view that teachers should be trained on how to ask learners questions appropriately and effectively. Furthermore, Shen emphasises that at the heart of teaching critical thinking skills to young learners is the teacher's ability to ask good questions. According to Fortino (2015), teachers should ask questions that allow learners to deepen their thinking. Hughes (2014) asserts that closed questions which require yes or no do not help learners to think critically but open questions are much more effective. Similarly, Guo (2013) believes that the most significant aspect of developing critical thinking skills in young learners may be enhanced through brainstorming.

2.8 Chorus responses and the development of critical thinking skills

Very limited literature has been found on chorusing in Zimbabwe, though chorusing seems to be very dominant in early childhood classrooms. Mtetwa et al. (2005, p.258) concluded that there

appeared to be relatively fewer public utterances by individual pupils compared with chorus utterances, especially in the lower grades, though they hesitated to describe the observation in terms of percentage estimates of proportions. In their conclusion, Mtetwa and his colleagues indicated that the teacher-learner interaction was dominated by chorus responses by learners to the teachers' questions or facts. The current research study assumes that the chanting and chorusing of answers does not enhance critical thinking skills in young learners because they do not give room for thinking. Thus, young learners learn better if they are given materials or props to interact with or if they are afforded the opportunity to interact amongst themselves. Hamlin and Wisneski (2012) emphasise the effective learning that learners engage in when simply interacting and responding to open-ended questions. Based on Hamlin and Wisneski's standpoint, when young learners interact and try things out, their critical thinking skills are enhanced as they explore different avenues to solve problems. However, when learners are imitating it means there is no room for thinking about their thinking and therefore prone to doing certain things unconsciously. Rote learning does not capture learners' attention and therefore less likely to enhance critical thinking skills.

2.9 Non-questioning learners and the development of critical thinking skills

In a research study conducted at Oxford, it was revealed that learners need to develop the skills of asking questions if they are to become effective critical thinkers (Hughes, 2014). Classroom teaching in most familiar contexts involves various aspects of questioning and clarifying and many effective mathematics classrooms are characterised by phrases of vibrant questioning. Aboluwodi (2016) argues that learners in Nigeria prefer to maintain their silence on issues and conform to what emanated from their teachers. Similarly, in all their observations of primary mathematics in Zimbabwe in 2005, Mtetwa and his associates noted very few incidents of individual learners publicly asking questions for clarification or for further exploration on the mathematical concept under study. Questioning is one of the ways early childhood teachers are likely to ensure that learners are thinking about their thinking or philosophising (Lipman, 2003). In the aforementioned research study by Mtetwa and associates, learners who were observed asking questions were either administrative or procedural, for example, 'Should we use pencil or pen? (Mtetwa, 2005.p.259).

The present research study intended to find out whether learners in Zimbabwean rural primary schools display characteristics of critical thinking by asking questions pertaining to mathematics

issues or clarification of concepts. Empirical research also indicated that learners in Zimbabwean primary school classrooms seem to see their role as that of responding to teachers' questions rather than asking questions and this orientation may derive from the wider home culture experienced outside the classroom that does not fully embrace the challenging of older people in positions of authority by younger people. The culture of not asking questions extends from home to the classroom where learners cannot challenge or ask teachers to clarify or repeat what they would have said even though learners have missed the point. In a study conducted in Nigeria, Aboluwodi (2016) pointed out that the culture of passivity is part of the larger society culture which emphasises conformity, hence the inability of learners to question other peoples' ideas. The acquisition of critical thinking skills in mathematics effectively requires an orientation that value open-mindedness and freedom to ask questions or seek clarification. The quest to find out if failure to ask questions during the teaching of mathematics has an influence on the development of critical thinking skills in learners gave the researcher the impetus to carry out the present research study in Zimbabwe.

2.10 Problem-solving and the development of critical thinking skills in young learners

Problem-solving is important in enhancing critical thinking skills because, when learners are trying to come up with a solution, they would be thinking critically. Fortino (2015), in a research study conducted in New York, noted that use of inquiry-based learning invited learners to pose meaningful questions and encouraged them to solve problems by experimenting and finding possible solutions. The activities that young learners engage in should be problem-based for problems offer young learners' chances to exercise and build a foundation for critical thinking. Dewey (1938) is of the view that, instead of teachers filling the minds of young learners with isolated skills, young learners should be actively involved in their own learning for them to solve problems. Similarly, Freire (1970) admits that for learners to be critical thinkers and problem solvers, they must be active participants in their own learning as opposed to vacant minds waiting to be filled with preordained information. When learners are solving problems, as such, they exercise independent judgment and explore several avenues to the solution of the problem. Thus, problems which might involve physical challenges, social relationship issues or understanding how things work often seem minor to us but provide great opportunities for learners to practice critical thinking skills.

From preschool to university level, research points to growing evidence that involving young learners in their own learning fosters critical thinking and problem-solving (Hamlin & Wisneski, 2012). Learning to think critically can be taken as one of the most important skills which today's learners will need for the future and teachers for young learners should enhance these skills though different means during mathematical activities or mathematics lessons. Fortino (2015) argues that it is the responsibility of early childhood teachers to nurture the innate curiosity of young learners in order to best equip youngsters with skills to become future problem solvers, researchers and critical thinkers. The role of the teacher in facilitating and nurture the development of critical thinking in young learners appears to be very important.

2.11 Perspectives on the teaching of critical thinking skills to young learners

The literature on critical thinking has its roots in different disciplines, namely philosophy, psychology and education (Ancill, 2014). These separate academic strands have led to the development of different definitions and therefore there has been little consensus on the definition of critical thinking. However, the way to teach and develop critical thinking in learners is still an ongoing debate. Young learners need some definition of critical thinking and even if there is no one definition, we can agree on some of the elements of the critical thinking process. During the 1980s, the main work of the critical thinking process in the field came from the USA. There has been a growing interest and research in developing critical thinking skills in Europe in recent years (ILO, 2012).

Learners are not born with the ability to think critically, and their prior learning experiences often do not require them to think critically. It is therefore crucial for teachers to provide experiences to foster thinking skills in order to prepare critical and informed learners for lifelong learning beyond the classroom (ACARA, 2013). There is a need to place importance in developing early childhood teachers who are capable of assisting learners to become critical thinkers from an early age. Sanders (2016) submits that research shows that, although teachers are often good at identifying the problems and deficits in the thinking of learners, they show less understanding of cognitive interventions needed to develop specific aspects of learners' thinking. This shows that learners ought to continually practice skills for them to become proficient. The present research study sought to find out how teachers of young learners facilitate the development of critical thinking skills in young learners during the teaching of mathematics to promote their mathematical literacy.

The nature of mathematics teaching and classroom activities is changing in an endeavour to meet the needs of today's learners. Australian Curriculum Assessment and Reporting Authority (ACARA, 2013) contend that critical thinking skills should be applied across the curriculum and beyond the classroom. The role of the teacher is changing from that of main instructor to that of a facilitator of mathematical activities to facilitate the development of critical thinking skills to promote mathematical literacy.

2.12 The psychological perspective on the development of critical thinking skills in young learners

Piaget (1964) believes that thinking occurs within a particular cognitive schema, a pattern that shapes how people see and process information, the assumptions they make and the guiding principles they apply to consider and solve problems. Dewey (1933) is of the view that critical thinking is an active persistent and careful consideration of any belief or supposed form of knowledge in the light of what learners may experience. Empirical research suggests that people begin developing critical thinking competencies at a very young age. Fortino (2016) argues that from preschool to university level, research points to growing evidence that inquiry-based instruction fosters critical thinking. Thus, teachers should provide explicitly instruction in critical thinking to teach how to transfer to new contexts and to use cooperative or collaborative learning methods that place learners at the centre of the learning process. Another psychological perspective rooted in the traditions of Vygotsky and Piaget emphasise the value of social interactions for promoting cognitive development. The socio-cultural perspective of learning is drawn from the work of Vygotsky who lived from 1896-1934. Vygotsky (1978) is of the view that the child constructs knowledge through interactions with other learners, the teacher and the environment. The socio-cultural epistemology claims that learning is not a result of individual construction but a result of participation with other people in societal activities with the assistance of a particular tool. The present research study sought to explore the teaching of critical thinking skills to young learners during the teaching of mathematics with an endeavour to find out the critical thinking skills exhibited by the young learners as they engaged in mathematical activities in a Zimbabwean context.

Hurst, Wallace and Nixon (2013) argue that the transfer of critical thinking skills across domains is unlikely unless learners are provided with sufficient opportunities to practise skills in a variety

of domains and the learners are explicitly taught to transfer. In a research study conducted in New York, Fortino (2015) indicated that teachers should facilitate and guide young learners to explore subject matter and to decide on the course of action to assist learners to apply the acquired knowledge in other situations. Transfer of learning is quite imperative because learners should be able to transfer and use mathematical concepts acquired in day to day use, what we can call mathematical literacy.

Early research in the Piagetian tradition tended to view cognitive processes of young learners as being deficient in relation to those of older individuals. Many following this tradition interpret Piaget' stages of development to mean that young learners are incapable of formal operations (abstract reasoning). Law (2012), in his research study at the University of Wellington, observes that young learners engage in many of the same cognitive processes that adults do, indicating that there is a place for critical thinking in lower elementary curriculum. This study sought to make use of observations to establish whether they were any critical thinking skills involved in learners' activities during mathematics teaching. A socio-cultural interpretation also suggests that, during social interactions, young learners bring their own views of the world which are influenced by the context they live in and the cultural tools that they interact with.

2.13 The philosophical perspective on the development of critical thinking skills

Schoenfeld (2015) commends that the overall philosophy of teaching young learners is to make them somehow richer from their experiences with the teacher. In London, a long-standing world-wide programme for teaching thinking that has been developed and adopted for use with young learners is that of Philosophy for Children (Lipman, 1988). Lipman grants that young learners are natural philosophers if they are given a chance to ask questions and have someone to discuss their ideas or with whom to argue a point of view or try out ideas to use if they make sense. According to this philosophy, young learners are not philosophers in the sense of coming to know all the answers but will begin to be philosophical when they wonder about the world and ask questions displaying some elements of critical thinking. For example, Tom aged five may ask: *Where does time go when it is over*? Janey aged four may ask: *Where do people go when they have died*? (Lipman, 1991).This shows that there is room for critical thinking in young learners if they are given a chance to stop and wonder why.

An important feature of the Philosophy for Children approach is that of discussion as the foundation of thinking skills. Philosophy for Children is ideal for the current research study because Cognitive Acceleration through Science Education (CASE) admits that there is growing evidence that Philosophy for Children can help accelerate literacy development in young learners. Since the current study explores the teaching of critical thinking skills to improve mathematical literacy with young learners, Philosophy for Children provides a well-researched methodology for developing the skills of critical, creative and collaborative thinking through discussion. There are several ways in which young learners can be assisted to think critically. The young learners may be given the opportunity to be philosophical, for example, through asking questions.

Determining whether critical thinking should be taught independently or integrated into the curriculum is a major debate surrounding this essential issue. Lipman (1988) contends that critical thinking should be taught as a separate course and bases his argument on the premise that an independent course would prevent learners from confining critical thinking skills to a specific subject matter, avoid repetition and encourages application of cognitive skills to other disciplines.

2.14 The sociological perspective on the development of critical thinking skills in young learners

Bates, Young and Campbell (2017) maintain that social thinkers like Plato, Rousseau, Augustine and Machiavelli argued that social behaviour was understood as the basic principle of human behaviour. Sociology thus attempts to understand behaviour at its different levels. Based on Bates and colleagues' standpoint, understanding the patterns of social interactions may assist teachers of young learners to apply the sociological advantage in teaching and learning situations. The present research study employed sociological aspects within the ambits of social constructivism to explore the teaching of critical thinking skills to young learners to enhance mathematical literacy. A research study conducted at the University of Oregon by Professor Conley found out that teaching critical thinking is vital for learners for it leads to other skills such as deeper analytic abilities and improved thought processing. The present research study saw it worthwhile to explore the teaching of critical thinking skills to young learners to improve mathematical literacy. Bates (2015) believes that sociology facilitates patterns of relationships that may probably lead to critical thinking since relationships are not consistent.

2.15 Developing young learners' critical thing skills

It is essential to develop critical thinking skills in young learners for a number of reasons (Zetriuslita, Ariawan & Nufus (2016). Drawing from Zetriuslita et al.'s viewpoint, it is necessary to teach young learners critical thinking skills since the benefits of critical thinking are lifelong supporting learners in the regulation of their learning capabilities subsequently empowering learners to critically contribute to their future profession. In a research study conducted at Franklin Pierce University, Cossette (2013) found out that critical thinking skills are a necessity in the classroom to bring about higher level of cognitive thinking. On the same note, Freire (1993) admits that the ability to think critically empowers young learners to become creative citizens in society. The Committee on the Undergraduate Programme in Mathematics (CUPM) concurs with the given sentiments through its recommendation that each course in mathematics should have the capacity to assist learners in the development of analytical, critical reasoning, problem-solving and communication skills. Firdaus and Baker (2015) argue that critical thinking skills are essential for learners to avoid learning by rote as young learners should learn mathematics by doing. Critical thinking thus enables young learners to make use of mathematics through active engagement. This research study sought to explore the teaching of critical thinking skills to young learners in an endeavour to find out how critical thinking skills are taught to young learners. Teachers have an obligation to equip young learners with skills so as to enhance transfer of learning in their classrooms into their future lives. For young learners to effectively function in the modern world and in future, they must be assisted to think critically.

Pavlovic, Babic and Baucal (2013) have shown that PISA (2012) international assessment studies in Serbia revealed that learners do not do well in responding to questions that require more than reproduction of knowledge. On the same note, Lidija and Milan (2017) argue that learners perform the worst when faced with tasks that demand critical thinking, use of available knowledge or problem-solving in a new context. In becoming proficient in mathematical literacy, young learners must have critical thinking skills.

Abrami, Bernard, Borokhovski, Waddington, Wade and Persson (2015) believe that teaching critical thinking is challenging because teachers have difficulties incorporating aspects of critical thinking into their lessons. Lidija and Milan (2017) concur that schools are still criticised for not facilitating or teaching young learners how to think. Although research studies have found that

critical thinking is lacking in the classrooms. Hughes (2014) stated that research is now clear that critical thinking skills may be developed and taught or integrated into teaching and learning situations. Critical thinking cannot be successful therefore if teachers fail to reflect on their own thinking, beliefs, lessons, instructional methods and ways to engage learners in the learning process.

2.16 Critical thinking and the child's personal benefits

Critical thinking skills are considered as the 21st century skills and have an important place in both educational environment and daily life (Slameto, 2014). Melo (2015) concurs that the 21st century advocates of teaching indicate that critical thinking is vital and must be part of the 21st curriculum. Ennis (2011) concedes that critical thinking attracts attention as an important element of life standards. Drawing from the needs of 21st century skills, the reason why critical thinking is so important to young learners is because it requires them to analyse their own thinking and actively participate in the learning process.

Cossette (2013), in a research study conducted at Franklin Pierce University, observes that without the ability to think critically learners are ill-equipped to handle many situations in which these skills are required. Moulding critical thinking skills in young learners is likely to enhance proficiency and confidence in all what they encounter in life. Based on the social constructivist perspective, young learners construct, invent, and analyse knowledge if they are given an opportunity to directly interact with their learning environment. In education, many teachers' basic goal is to teach critical thinking skills (Emir, 2013) because it makes learning easier and develops creativity in learners. Young learners cannot be taught to be creative by direct instruction but rather by exploring and experiencing environments that nurture creativity and critical thinking.

Cossette (2013) asserts that critical thinking is the focal point missed by many teachers because they teach memorisation with little time left for the development of critical thinking skills. It is therefore imperative to equip young learners with critical thinking skills because they have a lot of benefits for learners in their life time as members of society and in their careers in life (Lidija & Milan, 2017). Critical thinking is accepted as an essential element of life because it is a process whereby all scientific processes are considered, actions are taken from alternatives, and other people's thoughts are taken into consideration (Ennis, 1991). Individual benefits of the young

learner on critical thinking are necessary to explore during the teaching of mathematics in Zimbabwe.

2.17 Critical thinking and the child's academic benefits

Olalekan (2017) is of the view that critical thinking enables people to shape their personal opinions and attitudes without simply accepting issues with logically reasoned arguments from different perspectives. Chouari (2016) assumes that most countries of the world, including developing countries, have already stated implementing critical thinking in their curricula at different levels because the role of critical thinking in education has become pivotal. Similarly, Demirdag (2015) confirms that the results of critical thinking research studies in Nigeria show that education and critical thinking must go hand in hand to achieve educational goals. Karakoc (2016) argues that critical thinking offers young learners the opportunity to be objective, less emotional and more open-minded as one appreciates fellow learners' views. In support of these assertions, Ndofirepi (2014) affirms that critical thinking enhances a probing inquisitiveness and keenness of the mind. In a research study conducted in Nigeria, Aboluwodi (2016) comments that most teachers are still tied to the colonial education tradition where the most dominant practice is to teach learners to pass examination.

Bates (2015) is of the view that teaching critical thinking skills effectively in the classroom is crucial for developing some skills such as deeper analytic abilities and improved thought processing in learners. In a research study conducted in Georgia, Alexander (2014) found out that many critical thinking skills used by practitioners are aligned with those taught in courses such as analysis, identification of a problem, questioning and reflection. The same research study also identified other critical thinking skills such as evaluating, interpreting, predicting and reasoning as skills that may not be receiving the attention in deserved in the classroom. Contrary to the necessity of the skills identified as important to young learners, it was also noted in the same research study that a high percentage of practitioners use critical thinking skills in the field but very few of them were reported teaching the skills.

A research study in Minnesota universities identified critical thinking as a general education requirement, yet it remains difficult to determine the best method for teaching critical thinking and assessing gains in critical thinking (Saeger, 2014). Strong debates exist as to how best young learners may be assisted academically from the different instructional methods. The major debate

that seems to be the overarching theme surrounding critical thinking and young learner outcomes is whether critical thinking skills benefit the young learners and adds significant value to academic achievement. In his research studies, Ennis (1989) concluded that the best pedagogical approach to teaching critical thinking is when critical thinking skills are first taught separately then applied to course content. Based on the given views, it can be concluded that research studies involving instructional approaches and the development of critical thinking have produced inconsistent results. The inconsistent results support the need for additional research studies in the area of teaching critical thinking skills. The present research study therefore sought to explore the teaching of critical thinking skills to young learners in the 3-8-year age range to promote their mathematical literacy.

Saeger (2014), in a Minnesota research study, found out that critical thinking is a liberating force in education and a powerful resource in one's personal and civic life. Thus, educating good critical thinkers means working towards the ideal. The same research study indicated that critical thinking gives young learners a wider knowledge base and a better grasp of skills and concepts. It was also realised in the aforementioned Minnesota research study that critical thinking is much more than just logical reasoning, but it is more than a set of skills or processes. In fact, based on the given views, critical thinking skills are important for the learner's academic as well as future benefits. Exposing young learners to problems during the teaching of mathematics may thus facilitate the development of critical thinking skills which, in turn, may improve learners' mathematical literacy.

2.18 Conclusion

The present chapter reviewed related literature on critical thinking skills both internationally and in the Zimbabwean context with specific reference to the teaching of critical thinking skills to young learners. The chapter presents Zimbabwean literature on the aspects that are likely to influence development of critical thinking skills to mathematical literacy in Zimbabwean primary mathematics with special reference to learners in the 3-8-year age range. The influence of both local and international literature on the development of critical thinking skills has been explored in order to contextualise the present research study. The reviewed literature revealed some insights on factors that may influence the development of critical thinking skills in young learners, how critical thinking skills can be facilitated to improve mathematical literacy in learners and why it is

necessary to teach young learners critical thinking skills. The next chapter explores the theoretical framework that guides this research study

CHAPTER 3: THEORETICAL FRAMEWORK

3.1 Introduction

A theoretical framework is defined by Grant and Osanloo (2014, p.12) as the foundation from which all knowledge is constructed for a research study and this foundation serves as the "blueprint" for, or the structure that guides the entire research inquiry. This research study is premised on social constructivism which is a branch of constructivism. Schunk (2012) is of the view that social constructivism is situation specific and context bound and critically dependent on the qualities of collaborative process within an educational community. Social constructivism is rooted in constructivism whose origins are believed to date back to the time of Socrates. According to Vygotsky (1978), a learner constructs knowledge through interaction with other children, the teacher and the environment. Thus tenets of social constructivism, social interaction and scaffolding would be pivotal in exploring how critical thinking skills are acquired or fostered during the teaching and learning of mathematics of learners (3-8-year age bracket)

3.2 What is constructivism?

Amineh and Davatigari (2015) view constructivism as a synthesis of multiple theories diffused into one form. The two authors believe that constructivism is the assimilation of both behaviourist and cognitive ideals. Mvududu and Thiel-Burgess (2012) note that constructivism is widely praised as an approach to probe for learners' level of understanding and its belief that understanding can increase and change to higher level of thinking. Based on the given definitions, constructivism can therefore be referred to as a theory of knowledge that holds that learners generate knowledge and meaning from an interaction between their experiences and their ideas. Constructivism is believed to be one of the greatest influences on the practice of education in the last twenty-five years. Both Piaget's cognitive model and Vygotsky's social cognitive model describe constructivism as an activity where young learners may construct their knowledge and draw meaning from their previous knowledge as well as their environment. Rutherford (2012) views social constructivism as learning constructed in a social environment while personal constructivism is where learning is constructed within the individual based on prior knowledge.

Piaget (1977) asserts that learning does not occur passively; rather it occurs by the active construction of meaning. He believes that young learners encounter an experience or a situation

that challenges disequilibrium or a situation where imbalance is created. Based on Piaget's standpoint, social constructivism was found to be suitable for this research study because, if learners are in disequilibrium during the teaching of mathematics, they need to alter their thinking to resolve the equilibrium, thus engaging in critical thinking. This promotes or enhances learners' mathematical literacy during their learning of mathematics. Based on Piagetian epistemology, young learners make sense of new information during their learning of mathematics. This is likely to happen by restructuring their present knowledge to a higher level of thinking thus engaging in critical thinking skills that may in turn promote their mathematical literacy.

Vygotsky (1934-1986) proposed that the process of knowing is affected by other people and is mediated by community and culture. Vygotsky's position is suitable for this research study because the research study sought to explore the teaching of critical thinking skills during mathematics teaching, so as to promote mathematical literacy. Since constructivism is rooted in the process of knowing as mediated by other people, learners' critical thinking is viewed in respect of their teachers' influence during mathematics lessons or mathematical activities within the constructivist classroom, and the focus tends to shift from the teacher to young learners.

Based on the constructivist perspective, the classroom is no longer a place where the teacher pours knowledge into passive learners who wait like empty vessels to be filled. Within the constructivist model, young learners are urged to be actively involved in their own process of learning during teaching of mathematics. Denhere (2014) views the teacher as a facilitator who helps young learners develop and assess their understanding thereby fostering their critical thinking skills which in turn may lead to improvement in their mathematical literacy skills. Therefore, based on Vygotsky views, learning environments that actively engage young learners in the exploration of mathematical knowledge and the application of the knowledge are likely to promote learners' critical thinking skills and improve their mathematical literacy. However, critical thinking skills, like other skills, have to be learned and fine-tuned with the assistance and guidance of the teacher or the more knowledgeable other. Li (2012) views constructivism as a very important concept which can be applied in teaching and learning situations for the benefit of young learners. The next subhead focuses on social constructivism which is one of the branches of constructivism.

3.3 Social constructivism and young learners

Vygotsky (1978) added the social perspective of learning to constructivist theory and practice which is very important in the teaching of mathematics to young learners**.** Caine (2014), in an Australian research study, acknowledges that social constructivism dates back to Vygotsky whose research studies revealed that a learner often successfully accomplishes new tasks while working in collaboration with an adult or more knowledgeable peer. Amineh and Davatgari (2015) view social constructivism as a theory of knowledge in sociology and communication theory that examines the knowledge and understanding of the world that are developed jointly by individuals. Similarly, Thomas, Menon, Boruff, Rodriguez and Ahmed (2014) acknowledge that social constructivism is a sociological theory of knowledge that focuses on how individuals come to construct and apply knowledge in socially mediated contexts. Based on the given definitions, the fundamental premise of social constructivism is that knowledge is a human construction and the learner is an active participant in his/her learning process during teaching and learning of mathematics. In a research study conducted in the United States of America (USA),Gablinske (2014) found out that knowledge is socially constructed in social constructivism, and young learners create meaningful learning experiences through interaction with others. Surgenor (2012) asserts that social constructivism shares many of the tenets of constructivism, but places greater emphasis on social interactions, context, and socio-cultural factors in learners' learning. Learning is thus not viewed as an individual process but involves a large social network within which the learner's culture enhances the cognitive tools needed for development.

Vygotsky is the theorist most commonly associated with social constructivism and has formed the foundation of social constructivism in educational contexts (Vygotsky, 1978).An individual's knowledge of the world is bound to personal experiences and is mediated through interaction with others. Based on the given views, learning from a social constructivist perspective is an active process involving other people because knowledge is never acquired passively. In this research study, the focus was to explore critical thinking skills involved in the teaching of mathematics as a means of improving learners' mathematical literacy. Based on the viewpoints presented on social constructivism, young learners may acquire critical thinking skills as they interact with teachers, media and with each other. The current research study observed different group dynamics, for example, teacher-pupil interactions during the teaching of mathematics, teacher-group interaction as learners worked in groups, and learner to learner interaction as learners engaged in mathematical

activities. The different interaction dynamics were observed in a bid to explore critical thinking skills involved and the kind of support provided by teachers to assist in the development of critical thinking skills in young learners.

Social constructivists believe that learning occurs when individuals are engaged in activities such as interaction and collaboration (Doise, 2015). In view of this, young learners are likely to benefit through interacting with teachers and engaging in activities with peers in their acquisition of critical thinking skills during mathematical activities. Social constructivism is therefore suitable for this particular research study because the framework created opportunities for young learners as they interacted amongst themselves, with the media and with their teachers. Critical thinking skills were fostered within the ambits of social constructivism because social interaction afforded teachers and young learners an opportunity to draw from individual experiences and to explore learning beyond content and subject matter. In a research study conducted in Columbia, Li (2012) revealed that critical thinking is a complex mental process involving paying attention to metacognitive thinking such as reflection and higher order thinking. Based on the aforementioned research study, teachers should engage young learners in critical thinking skills so that young learners may interpret the experiences and achievements of their peers and analyse how they relate to their own perspectives. Such engagement and operations are likely to enhance critical thinking and improve learners' mathematical literacy during the teaching and learning of mathematics.

3.4 The social constructivist view of young learners' learning

Social constructivism, strongly influenced by Vygotsky's (1978) work, proffers that knowledge is first constructed within a social context and then internalised and used by individuals. Caine (2014), in an Australian research study noted that each learner is different, and each has an individual meaningful way of learning and the personal perspective which helps to bring life meaning to all other aspects of mastering a skill. In the same research study, it was also emphasised that learning only happens when the learner makes sense of things for him/herself. Similarly, social constructivist scholars view learning as an active process where young learners should learn to discover principles, concepts and facts for themselves (Li, 2012). Borrowing from the given viewpoint, young learners may be assisted to acquire critical thinking skills through active engagement during mathematics lessons or mathematical activities either in pairs or in groups. A central tenet of social constructivist perspective is that a child constructs knowledge through

interaction with other children. Social interaction, as one of the constructs of social constructivism, is likely to be rooted in how learners acquire knowledge and skills. Draper (2013) argues that social constructivism does not see a classroom as a place where the teacher pours knowledge into passive learners but emphasises active involvement in which young learners interact and create knowledge.

Vygotsky (1978) asserts that learning is a continual movement from the current intellectual level to a higher level of a learner's potential during teaching and learning. Thus, critical thinking skills can improve from one level to another through learner to learner interaction or teacher to learner interaction. According to Vygotsky (1978), the movement occurs in the zone of proximal development (ZPD) as a result of social interaction. The ZPD has been defined as "the distance between the actual development level as determined by independent problem-solving under adult guidance or in collaboration with more capable peers" (Vygotsky 1978, p.86). Based on Vygotsky's standpoint, the social environment proves to be crucial in the learning of young learners. The researcher therefore based this study on social constructivism as a framework that would inform the research. Doise (2015) argues that social interaction is emphasised since individual learners construct understanding through talk and interaction with others.

A research study conducted by Hurst, Wallace and Nixon (2013) at Missouri State University found out that social interaction created a positive working environment and provided means for learners to view subject matter from a multi-perspective leading to critical thinking and problem-solving. Based on social constructivism, a learner understands and constructs knowledge or meaning through social interaction and shared meaning with peers. Learning that is socially constructed continually challenges the thinking of learners and emphasises the personal meaning they make. The researcher therefore saw it worthwhile to explore the teaching of critical thinking skills to improve mathematical literacy with learners in the 3-8 age range. The study is framed within the ambits of social constructivism. Since it allows teacher-learner interaction as well as learner -learner interaction in the acquisition of critical thinking skills during the teaching and learning of mathematics, social constructivism was seen as suitable to this research study.

For Vygotsky (1978),the critical thinking skills of young learners may be enhanced through interactions with more knowledgeable peers or interactions with their teachers where they can be

assisted (scaffolding) to reach their levels of potential during the teaching of mathematics. Vygotsky (1978) claims that Piaget overlooked the social nature of knowledge in which learning is a collaborative process. Based on the social constructivist epistemology, the problem-solving technique guides young learners through the critical thinking process and utilises learners' collaboration. Vygotsky distinguished between two developmental levels, namely the level of actual development and the level of potential. In the actual level of development, young learners may be capable of solving problems independently. In the level of potential development, the young learners are capable of solving mathematical problems with the guidance of the teacher or in collaboration with peers. Within the ambits of social constructivism, young learners acquire mathematical concepts through social interaction and not only through assimilation and accommodation. Therefore, based on the social constructivist perspective, young learners may also be guided to think critically if they are given the opportunity to work with others in solving mathematical problems. Additionally, young learners are likely to become mathematically literate as they become integrated in the knowledge community.

From asocial constructivist view, without social interaction with a more knowledgeable other, it is impossible to acquire social meaning of important symbol systems and learn how to use them. Social constructivism is therefore suitable for the current research since learners are likely to benefit greatly through interacting with other learners in the teaching of mathematics by using examples within their context. Vygotsky (1978) argues that all cognitive functions originate in, and are products of, social interaction since it is not possible to separate learning from its context. Sohel (2012) acknowledges that social constructivists value both the context in which learning occurs and the social contexts that learners bring to their environment.

3.5 Social interaction and development of learners' critical thinking skills

The social constructivist theory is based on the belief that young learners construct knowledge through an active mind-engaging process where critical thinking skills may be developed by mentally acting upon information during the teaching and learning situation. Hurst, Wallace and Nixon (2013) submit that, while social interaction becomes part of the classroom system, teaching becomes active with interaction going amongst young learners and between teachers and learners. In their Missourian research study, Hurst, Wallace and Nixon (2013) sought to find out how social interaction contributed to learning. In an analysis of 180 responses regarding how social interaction

affected learning, four themes accounted for 57% of the responses. Of the findings, 23% indicated that social interaction helps learners learn from others, 16% indicated that social interaction makes learning fun, 10% got learners interested and engaged, and 8% allowed learners to talk in the classroom.

An analysis of the data generated from the aforementioned research study indicated that young learners learn from others through active engagement of prior knowledge. Learning may happen by engaging comprehension through asking questions to make conclusions and consolidate ideas. The research study also revealed that social interaction created a positive working environment and provided a means for young learners to view the world from multi-perspectives to enhance critical thinking and problem-solving. Based on Hurst et al. (2013) research study, social interaction may be important in the teaching of mathematics for the development of critical thinking skills in young learners. In other words, interacting with peers during the teaching of mathematics contributes greatly to learning by young people. Social interaction in group activities in which young learners assist each other increases the responsibility of the individual in his thinking process thereby increasing critical thinking skills of each learner (Geng, 2014). Along similar lines, Ryu, Parsons and Lee (2014), in their research study conducted in Poland, revealed that collaborative learning in which young learners assist one another challenges every learner to help develop critical thinking skills.

This notion of social interaction is strongly supported by Dewey (1963) who argues that conversation helps individuals make sense of their world. Hurst et al. (2013) contend that learners learnt from each other, thus enhancing comprehension and retention by activating prior knowledge and making connections which lead to the consolidation of new ideas. Social constructivists include critical thinking skills as one of the lists of the essential skills needed in life and believe that young learners need critical thinking skills for their future use (Galinsky, 2013). The social constructivists acknowledge that learning involves building on the background knowledge the young learner brings to the classroom. In other words, learning occurs within social contexts that young learners bring to their environment. It is most likely therefore that young learners become mathematically literate if the teaching of mathematics is related to the contexts in which they live.

According to Dewey (1963), the concept of teachers doing all the talking during the teaching of mathematics is in direct contrast to the philosophy that learning is primarily a social activity. Deducing from the given views, one way for young learners to shoulder the responsibility for learning during the teaching of mathematics is for them to become critical thinkers could be through active engaging in social interaction with others. The social constructivist theory is based on the belief that individuals construct knowledge and understanding and that constructing understandings of one's world is an active, mind engaging process (Hurst et al., 2013, p.377).

In a research study conducted in Nairobi, Kibiu (2012) noted that the acquisition of critical thinking skills by young learners is important if they are going to face challenges posed in society. The aforementioned research study established that it is not necessarily the case that use of social interaction by teachers of young learners leads to improvement of critical thinking skills. On the contrary, in another research study in Iran, Hajhossein, Zandi, Shabana and Madana (2016) revealed that the components of critical thinking dispositions and social interaction were mostly displayed during discussions. Brookfield (2012) is one of the proponents who claim that critical thinking and social interaction can be facilitated through discussions. Hajhossein et al. (2016) and Brookfield (2012) concur that young learners may also be given the opportunity to discuss freely in their groups during the teaching of mathematics for them to acquire critical thinking skills. The given views illustrate an assumption that young learners' autonomy may lead to development of critical thinking skills. Findings of the research study by Hajhossein et al. (2016) showed that discussion-based teaching promotes deep understanding by making young learners question their mathematical knowledge. Ultimately involvement of young learners in class discussions or group discussions seem to have benefits as compared to the traditional way of teaching where the teacher would convey knowledge to passive recipients who do not even discuss or question. Teachers, therefore, should not control everything during the teaching of mathematics but should make learners responsible for their learning by granting the young learners the responsibility to construct knowledge. Social constructivists believe that young learners from different backgrounds often bring different cultural knowledge and social perspectives into classrooms. This subsequent interaction is more likely to enhance critical thinking through learning of new mathematical understanding or mathematical literacy.

3.6 Social constructivist view of scaffolding

Bruner (1986) is of the view that the concept of scaffolding originated in research on how mothers assisted their babies to learn language. Bakker, Smit and Wegerif (2015) argue that in educational research the concept of scaffolding has gained popularity over the past decades. Scaffolding can be viewed as the process that enables a young learner to solve a problem which would be beyond his or her capability without assistance (Calder, 2015). Several definitions of scaffolding have been formulated over the years. Belland (2014) believes that the concept of scaffolding has both social and technological dimensions. Bell and Pape (2012) view social scaffolding as the support of social norms in the classroom and apart from the social interaction extension there is also extension towards technology. In the social dimension, Belland (2014) took note of three different ways in which interaction can take place, that is, one-to-one interaction, peer interaction, and computer-based scaffolding. The three modalities have a potential to work very well in the teaching of mathematics with young learners.

Reiser and Tabak (2014) believe that technological tools play a crucial role in supporting young learners towards the development of critical thinking skills. Bakker et al. (2015) place the teacher at the centre of technological scaffolding since he or she is the one who decides when to use the tools or when to withdraw the tools during the teaching of mathematics. Kaiser (2015) proposed ways in which social scaffolding can be seen in the teaching of mathematics. First, teachers are supposed to adapt their support to young learners. Secondly, teachers gradually withdraw their support in a process known as fading. Lastly, teachers transfer the responsibility to young learners who then become independent in solving problems. The aforementioned views inform teachers on how they may make use of scaffolding during the teaching of mathematics to young learners.

Hunter (2012) argues that many features of scaffolding have been noted in teaching and learning situation apart from social and technological dimensions. From the social constructivist epistemology, the concept of scaffolding is thus imported in the teaching of mathematics in the sense that young learners have to work alone, work in groups as peers as well as interact with technological tools. As young learners explore the different modalities in the quest for mathematical knowledge, they engage in critical thinking which in turn may lead to improvement in mathematical literacy.

Social constructivists suggest that cognitive growth first happens at a social level then proceeds to an individual level at a later stage (Vygotsky, 1978). In this regard, young learners are given the opportunity to exercise their own thinking thereby engaging in critical thinking to make sense of the world around them, thus, the zone of proximal development (ZPD) is emphasised. Based on the concept of the ZPD, social constructivists are of the view that teachers of young learners ought to provide support to learners and then gradually decrease the support as the young learners learn independently. On the same note, Piaget (1977) argues that the role of young learners has since changed from passive to active participation in their own learning. Thus, in social constructivism importance is centred on collaboration where young learners work in pairs or in groups and later on their own while the teacher works as a facilitator. The social constructivist epistemology views the teaching of mathematics to young learners as working in collaboration and the support may be withdrawn to let learners make learner centred advances in their understanding. In this regard, the teaching of mathematics to enhance critical thinking skills in young learners becomes less directive and teachers are there to guide learners to actively construct knowledge.

3.7 Cognitive tools and young learners' acquisition of critical thinking skills

The cognitive tools perspective focuses on the learning of cognitive skills and strategies young learners engage in during the social learning activities that involve a hands-on project-based method (Bazluki, Chamberlain, Martin & Mitchell, 2012). In this perspective, learners produce a product and, as a group, impose meaning on it through the social learning process. Li (2012) views cognitive tools as any tool that can support aspects of learners' cognitive processes that may allow young learners to generate and test their hypotheses in the context of problem-solving. Thus, on the basis of the presented views, learners' critical thinking skills may be enhanced while interacting with cognitive tools and peers. This is so since young learners should be directly involved in mathematical activities rather than memorisation and chanting of answers in chorus. However, in a research study carried out at the University of Michigan, Brent, Elliot and Washington (2017) confirmed that there are several challenges that may be encountered with the cognitive tools approach to learning because effectiveness of the tools results from activities and the context within which the tool is used.

The teaching of mathematics to young learners in this era of technological advancement where tools are seen as scaffolds is becoming more and more noticeable. Belland et al. (2015) agree that

tools play an important role in supporting young learners towards the acquisition of content and skills. This places technological tools as significant scaffolds in the teaching of mathematics to young learners to improve their critical thinking skills. Additionally, Bakker et al. (2015) place importance on the teachers' role and their responsibility of deciding the kind of tools to be used in the teaching of mathematics to enhance critical thinking and when to withdraw the tools from instruction. Central to the notion of tools as scaffolds is the issue of transfer of responsibility where the young learner works on his or her own in solving mathematically related problems.

3.8 The social constructivist view on how to teach young learners

Social constructivist teaching approaches emphasise reciprocal teaching, peer collaboration, problem-based instruction, and other methods that involve learning with others (Vygotsky, 1978). In this respect, young learners should be left to explore and interact with peers during mathematics lessons or mathematical activities for them to develop critical thinking skills. In a research study conducted in 2017, the Berkeley Graduate Division in California noted that young learners should be involved in their own learning to benefit from instruction as they learn best by doing rather than being told. More generally, the research study indicated that collaborative learning should be seen as a process of peer interaction that is mediated and structured by the teacher. Asander (2016) maintains that an environment which emphasises learners' active engagement in the learning process is likely to lead to their mental agility.

In another research study conducted in 2015 in Chicago, Beilock (2015) found out that reading about a concept in a textbook or seeing a demonstration in class is not the same as physically experiencing what learners would be learning about. Based on the pragmatist epistemology, young learners learn by doing. Thus, the teacher's role is that of a guide or facilitator who makes things happen while playing a lesser role in the teaching of mathematics.

3.9 The social constructivist view of a young learner

Social constructivism stresses the importance of learners' social interaction with knowledgeable members of society (Vygotsky, 1978). Based on Vygotsky's viewpoint, the acquisition of social meaning of important symbol systems and learning how to utilise them are dependent on social interaction with other more knowledgeable people. Amineh and Davatgiri (2015), in a research study conducted in Iran, added that young learners develop their thinking abilities through

interaction with other learners, adults and the physical world. Learners' critical thinking skills during mathematics lessons or mathematical activities are likely to be developed through interacting with their teachers, peers and concrete materials. In addition, from a social constructivist viewpoint, it is important to take into account the background and culture of learners during teaching and learning process. Based on the aforementioned research study, all the props, materials and even examples used during mathematics lessons or mathematical activities ought to be within the learner's experience for them to benefit from the instruction. Cossette (2013) claims that, without the ability to think critically, young learners are ill-equipped to handle many situations in which those skills are required.

3.10 The social constructivist view of a teacher who teaches young learners

It is very crucial for a teacher to create a supportive and collaborative environment to foster the development and application of thinking skills by young learners (Kwan & Wong 2014). Topoglu (2013) concurs that a teacher has a vital role in the classroom to create an appropriate environment for learners to think critically. Amineh and Davatgiri (2015) maintain that social constructivism stresses the importance of the learner's social interaction with knowledgeable others. Based on the preceding point of view on the social constructivist approach, teachers are more of facilitators and regard every learner as an integral part of the learning process. When the teacher just teaches, the learner plays a passive role but if the teacher facilitates the learning process it helps learners to learn and increase the chances of acquiring critical thinking skills. Sanders (2016) views critical thinking skills as fundamental to young learners' learning and application of mathematics.

Young learners maybe guided by their teachers to think critically during mathematics lessons or mathematical activities. Sun and van Es (2015) argue that the type of learning environments has a significant influence on learners' ability to think critically. The designed learning environment should support and challenge learners' thinking. Kong (2015) is of the view that a supportive learning environment that builds upon the principles of social constructivism fosters a learner's critical thinking skills in mathematics classrooms. Yuliani and Saragih (2015) assert that higher order thinking skills are integral to learners' mathematical activities. Therefore, learners should be encouraged to have several possible solutions to become effective and critical thinkers at large. Cossette (2013) recommends that teachers use their time effectively by soliciting information, listening and asking questions to enhance critical thinking skills rather than doing all of the talking.

3.11 The social constructivist view on facilitating learners' critical thinking skills

The concept of critical thinking is not new in the education system but was found about hundred years ago and counted as one of the learning skills considered as compulsory in the 21th century (Greenstein, 2012, p.22).A research study conducted by Kowalcyk, Hackworth and Smith (2012) in Cambodia revealed that the lack of appropriate instructional materials, lack of knowledge of how to promote learners' critical thinking skills and lack of learners' motivation to become critical thinkers are obstacles to improving critical thinking in young learners. UNESCO (2013) notes that mobile technology also supports teachers in individualising instruction to accommodate learners' unique needs enabling every learner to engage in own learning. Scott (2015) mentions that in 2012 the Colombian government purchased 250,000 mobile devices equipped with interactive educational software and delivered them to illiterate young people and adults and this improved mathematical literacy. The role of teachers in the 21st century must move away from imparting knowledge towards guiding young learners to attain their learning goals (UNESCO, 2013).Bull and Gilbert (2012) define the role of the teacher as that of a learning coach who provides guidance to young learners to develop critical thinking skills by offering the kind of support necessary to develop the skills. Based on the given views, teachers may facilitate the development of critical thinking skills in young learners by including technological devices for learners to interact with during the teaching of mathematics. Information and communication technology (ICT) may allow for more learner-centred approaches which are likely to increase the chances of enhancing critical thinking skills and improve mathematical literacy in the young learners.

3.12 Integrating social constructivism in young learners' classrooms

Social constructivist approaches have the potential to make learners use ideas in actively building their understanding through the zone of proximal development (ZPD) (Vygotsky, 1978). Vygotsky believes that learners are assisted by other knowledgeable persons such as teachers and peers to become aware of their own learning through metacognition and this happens gradually. Based on the social constructivist epistemology, young learners would work in groups during mathematical activities and assist one another to gain understanding of the concepts as well as how to make use of the acquired knowledge in their day to day living (mathematical literacy).In their research study, Hurst et al. (2013) concluded that social interaction enhanced critical thinking and problem-solving and the best way to teach these skills was through small group discussions. A young learner is therefore likely to acquire mathematical concepts through interaction with peers and exploring

different avenues as they share ideas and may in turn allow the development of critical thinking skills and improvement in mathematical literacy. Sharma (2015) argues that a collaborative learning environment encourages young learners to actively explore mathematical problems using their own ideas and strategies and may lead to positive experiences that may in turn foster critical thinking skills in young learners.

Social constructivists believe that direct physical interaction with materials is often effective in enhancing learners' critical thinking (Beilock, 2017). Social constructivists believe that handling physical materials extends learners' sensory experiences and this may facilitate their mental reasoning. Similarly, Dewey (1963) argues that the concept of teachers doing all of the talking in classrooms is in direct contrast with the philosophy that learning is a social activity. Therefore, the use of teaching resources is imperative during mathematics and mathematical activities because conceptual understanding is enhanced through the assistance of physical manipulation. Rutherford (2012) contends that active engagement and conversations assist individuals to make sense of the world. Based on the given views, teachers of young learners have an obligation to provide learners with concrete manipulative skills to gain understanding and improvement in mathematical literacy. Social constructivists believe that the development of critical thinking skills enable young learners to work together mathematically and become effective problem solvers (Tunica, 2015). This happens as young learners adjust their mental models to accommodate new information through sharing and helping each other make progress through the zone of proximal development (Piaget, 1977; Vygotsky, 1978).

The Vygotskian perspective acknowledges that within the ambits of social constructivism, teachers are in the habit of introducing their own ideas and information before learners have a chance to think out their ideas and therefore learners will take the easier route to accepting what their teachers say. It is against this background that this research study realises the importance of probing learners' understanding revolving around what they think about given problems before providing them with answers. Given the opportunity to think or articulate their views, avenues for critical thinking are opened for young learners to explore. Beilock (2017), in his study submits that social constructivists encourage young learners to engage in dialogue both with the teacher and amongst each other. Social constructivism thus acknowledges that the mediation of knowledge between two or more young learners promotes intellectual progress that may lead to the development of

critical thinking skills and improvement in mathematical literacy. In other words, social constructivism places the use of group work during mathematical activities at the centre of learners' learning for critical thinking skills to develop. In a research study conducted by Hurst et al. (2013), 23% out of 57% of the respondents on how social interaction impacted on learning indicated that social interaction helps young learners to learn from each other. Therefore, based on Hurst and co-workers' standpoint, learners may understand the world as they interact both with materials and other people during the teaching of mathematics.

Kibui (2012) carried out a research study in Nairobi and found that through discussion or argument, social mediation of knowledge is enhanced which may lead to the development of shared meaning. Based on Kibuis' (2012) findings, working together to solve mathematical problems may enhance a common understanding after young learners have considered the different views given by the group members. Therefore, in considering the different views young learners would have exercised their critical thinking skills to come up with a socially negotiated outcome. From the aforementioned research study, it can also be deduced that working together in solving mathematical problems may assist young learners in preparation for life because several skills are enhanced including critical thinking skills and social skills, resulting in a team spirit. This creates respect for other peoples' contributions; even incorrect answers are respected, although they may not be accepted by the group.

The notions of social constructivism are therefore important to consider for the teaching of mathematics to young learners since they share ideas and views as well as assist each other with challenges experienced. The Vygotskian perspective acknowledges that, if young learners are given the opportunity to work as peers, they assist each other within the ZPD by supporting those who are less knowledgeable (Vygotsky, 1978).

The production of more ideas and questioning by young learners are indicators of exercising critical thinking skills. Cutting short or preventing a response from someone who is finding it difficult to express his or her ideas is not helpful, especially in the development of critical thinking skills. The aforementioned Nairobi research study by Kibui (2012) indicates that critical thinking is best developed in an intellectual atmosphere where intellectual exchanges and dialogue are valued. Topolgtu (2014) is of the view that questioning by young learners activates the reasoning

capacity enabling learners to reach satisfying conclusion and feel good about their thinking whenever they participate in mathematical activities. Learners' awareness of their thinking can also enhance the development of critical thinking by encouraging young learners to reflect about their own strategies and learning styles.

Social constructivists believe that effective work may be carried out in small groups where young learners are explicitly expected to take time over a task or problem and then present the results of their combined thinking to the rest of the class. From a social constructivist viewpoint, young learners interact with the physical environment as well as with other learners for them to acquire meaning of their experiences (Kibui, 2012). Social constructivism posits that it is beneficial if young learners are given mathematical problems and work in groups to construct solutions. Vygotsky's principles remind us that teachers should guide and support young learners through a new level of competence while tailoring teaching to involve learner generated advances in understanding (Winstone & Millward, 2012). Based on the aforementioned viewpoint, learners may stretch their imagination in exploration of their critical thinking skills during the teaching of mathematics. Indeed, for Vygotsky, teaching should be less directive and young learners should be assisted to make advance for their personal academic benefit as they explore the world in their quest for knowledge.

3.13 The social constructivist views on child-centred methods and the development of critical thinking skills in young learners

Social constructivists believe that child-centred methods improve learners' critical thinking skills. Sayre (2013) conducted a research study in Florida and established that child-centred methods are effective in enhancing critical thinking skills to young learners because these methods incorporate several learning styles giving young learners the opportunity to become active in their own learning. The aforementioned research study also notes that, as long as young learners have control of their thinking, they can begin to build critical thinking skills. Gallavan and Kotller (2012) asserts that cooperative learning may play a major role in child-centred learning because young learners are interdependent on each other in the learning process, participating in problem-solving, group discussions, making decisions and ensuring that the project is completed since each learner is held accountable. Kracl (2012) argues that young learners become self-directed and start asking questions leading to continue to seeking answers and this promotes thinking critically.

3.14 Social constructivism and the teaching of critical thinking skills during mathematical activities

Vygotsky (1986) is of the view that learners' knowledge emerges from a repertoire of daily experiences and interaction with adults and peers. The basic notion of Vygotsky's social constructivist perspective is that the learning and development of learners take place during social interaction. Sanders (2016) maintains that, as young learners are learning mathematics, they are learning critical thinking skills which they use to become successful adults, and this is mathematical literacy. However, the question remains as to how the teachers ensure young learners learn to be critical thinkers. Kracl (2012) proposes that critical thinking is more than just being rational, but young learners should be able to work together, draw their conclusions and make their own minds on matters without much influence from the teacher for them to acquire critical thinking. Topolgtu (2014) submits that a teacher is a catalyst that provides motivation for learners to engage in critical thinking during an instruction.

Vygotsky's (1978) social constructivist theory promotes the use of group learning in the teaching of mathematics. Based on the Vygotskian perspective, cooperative or group learning results in a positive outcome in developing learners' higher-level reasoning and critical thinking skills. In a research study carried at Missouri University, Hurst, Wallace and Nixon (2013) found that, in group activities, young learners take a form of group learning environment embedded in principles of cooperative learning. The element of critical thinking is therefore promoted as learners interact during group activities. In the context of group learning, young learners challenge each other's views or ideas during interaction therefore paving way for critical thinking to take place. The research study by Hurst, Wallace and Nixon (2013) also revealed that learners become good listeners during social interaction and, where possible, offer different alternatives to a problem. In the same research study, it was also noted that social interaction provided a means for young learners to view problems from a multiple perspective which enhanced learners' critical thinking and problem-solving skills. Based on the aforementioned research study, a strong connection between social interaction in the classroom and learners' learning may be realised as young learners engage in mathematical activities. Furthermore, the importance of discussions as a method of instruction for developing critical thinking has been revealed. Empirical evidence has also shown that social interaction is important in teaching of mathematics to young learners because, when there is talking, learning and thinking also take place.

3.15 Conclusion

The chapter explored the social constructivist epistemology in relation to learners' learning and development of critical thinking skills to improve mathematical literacy. It was with this in mind that the researcher explored the connection between social constructivism and the teaching of critical thinking skills to improve mathematical literacy in young learners. The theoretical framework that guides the research study has been articulated in view of the young learners and the different views that emerge from social constructivism. Furthermore, local and international literature on the teaching of critical thinking skills to improve mathematical literacy during the teaching of mathematics were explored within the ambits of social constructivism. The next chapter focuses on the research methodology.

CHAPTER 4: RESEARCH METHODOLOGY

4.1 Introduction

The study explored the teaching of critical thinking skills to young learners to promote their mathematical literacy in Zimbabwean primary schools. The previous chapter sought to highlight the relationship between social constructivist theory and how young learners learn and, furthermore, how teachers foster critical thinking skills to improve mathematical literacy. In the current chapter, the research methodology is discussed and aspects under discussion include research design, sample, instrumentation, procedure, data analysis, pilot testing, trustworthiness and ethical issues. The current research study adopts a research methodology which aims to:

- explore factors that are related to the teaching of critical thinking skills to promote mathematical literacy in young learners in the 3-8-year age range;
- find out how teachers facilitate the development of critical thinking skills to promote mathematical literacy in young learners;
- establish why it is important to teach young learners critical thinking skills.

With the aim of addressing the above-mentioned research objectives, this chapter further presents detailed discussions of the research approach, research paradigm and research design for the current study.

4.2 Exploring the qualitative research approach

Creswell (2014) submits that the qualitative approach involves an interpretive and naturalistic approach to the world. Roller (2014) is of the view that qualitative researchers study things in their natural settings, attempting to make sense of or interpret phenomena in terms of the meanings people bring to them. Terrell (2012) argues that in qualitative research the researcher accurately records in the exact way that he or she sees or hears from respondents. Based on the aforementioned views qualitative research may be regarded as a situational activity that locates the observer in the world. This research study employed the qualitative approach because it is an exploration on how teachers teach critical thinking skills to improve mathematical literacy in young learners they teach. The exploration relies on first-hand information as to how teachers teach critical thinking skills during mathematics lessons so as to promote mathematical literacy. Within qualitative research, the researchers' activity involves and attempts to understand and

explain social phenomenon in order to solve problems at hand. Furthermore, qualitative methods are useful when the researcher focuses on the dynamics of the process and requires a deeper understanding of behaviour and the meaning and context of complex phenomenon (Check, Russell & Schult, 2012).Gary (2011) concurs that it is the most appropriate approach to studying a wide range of social dimensions while maintaining contextual focus. Denzin and Lincoln (2011) believe that qualitative research approaches are diverse, consisting of a variety of philosophical paradigms such as interpretive, phenomenology, ethnographic, feminism, constructivism, social realism, critical theory, and symbolic interactionism, among others.

Creswell (2013) argues that qualitative researchers tend to collect data in the field at the site where participants experience the issue or problem under study. Qualitative researchers do not bring individuals into a contrived situation nor do they typically send out instruments for individuals to complete but do field work to generate the data (Check, Russell & Schult, 2012).The use of interviews of teachers teaching mathematics to young learners as well as observations of young learners engaged in activities were therefore seen as crucial in this research study.

Denzin and Lincoln (2011) noted that the researcher becomes central to the analysis of data since he/she collects data from a specified phenomenon. Creswell (2014) agrees that qualitative researchers collect data at the site where participants experience the problem under study. Qualitative researchers are therefore key elements in the collection of data since they collect data themselves through interviews and observing behaviour. Stronge and Tucker (2012) are of the conviction that qualitative researchers use multiple sources of data and do not rely on a single source. In this particular research study, observations and interviews were used to generate data in natural settings, i.e., the classroom. Pereira (2012) maintains that, through interviewing participants, in-depth feelings and attitudes towards the phenomenon may be revealed. In this study, the researcher interviewed teachers and observed the entities of teaching and learning process in the natural setting. The study thus explored young learners' mathematics learning situations and the teaching of critical thinking skills to young learners to improve mathematical literacy. Qualitative research was suitable for this research study since the exploration was done in a natural learning environment.

However, qualitative research has its own challenges such as bias as a result of personal interpretations of the researcher (Creswell, 2014). Furthermore, Yin (2014) is of the view that data

can be untruthful because participants can be biased towards certain specifics. In this research study the researcher reduced chances of bias by creating a cordial environment during interviews and observations to gain the confidence of participants and probing was done where necessary to counter the perceived weaknesses. However, based on the given sentiments, results may be influenced by many other factors that the researchers may not be aware of. Creswell (2014), for example, argues that replication of results may be difficult due to the different factors encountered during the research process. The next section focuses on the phenomenological paradigm.

4.3 Exploring the phenomenological paradigm

This research study employed the phenomenological world view to obtain a rich and complete description of teachers and their learners' experiences in natural settings or real situations during the teaching of critical thinking skills to young learners in a bid to improve their mathematical literacy. Creswell (2014) is of the conviction that, within the phenomenological worldview, any manner in which participants can describe their lived experiences may be used to generate data in a phenomenological research study. The phenomenological paradigm was found suitable for this research study since it aims to explore the teaching of critical thinking skills to young learners during mathematics lessons or mathematical activities to promote their mathematical literacy.

Yin (2014) contends that by emphasising the study of the phenomenon within its real-world context, the researcher collects data in natural settings compared to relying on derived data. In this sense, findings are meant to emerge, rather than being imposed by the researcher. Pereira (2012) investigated thoroughness in phenomenological research and concluded that, for a phenomenological research study to be judged valid, researchers must take into consideration rigorous and appropriate procedures and experiential concerns that provide insight in the lived experiences.

A phenomenological world view has been employed in the particular research study in an attempt to understand the teaching of critical thinking skills to young learners to promote their mathematical literacy. Creswell (2013) concedes that phenomenology begins with a phenomenon under consideration rather than beginning with a theory. Thus, on the basis of the preceding views, the central concern in a phenomenological research study is to describe the phenomenon without basing on any pre-determined framework. In line with the given sentiments, data for the present research study was generated from a natural setting using interviews with teachers, observations

of teachers teaching mathematics and observations of learners engaged in classroom activities. Teachers were observed teaching real classes in real classrooms. Each interview was conducted in the participant's classroom after the learners were dismissed. Young learners were observed in groups of 3-13 members engaged in mathematical activities. This means data was collected in natural settings. Wildman (2015) concedes that phenomenological research studies explore the essence of experiences of individuals or groups with first-hand accounts.

Davidsen (2012) concurs that phenomenology is used to generate an account that permits the researcher to gain insight into the experiences that an individual may have undergone. With regard to the teaching of critical thinking skills to improve mathematical literacy, human behaviour ought to be understood through the eyes of participants in the research study by interacting with them verbally, seeing them, analysing and interpreting their behaviours in context. According to Check, Russell and Schult (2012), qualitative researchers often use a technique called the case study.

4.4 The research design

Yin (2012) is of the view that case studies arise out of the desire to understand complex social phenomenon and allows the exploration to retain holistic and meaningful characteristics of real-life events. Case studies therefore make use of the phenomenon within its real context while generating data in natural settings. Roller and Lavrakas (2015) believe that a case study design may include single or multiple case studies. The present research study used multiple cases where five schools were conveniently selected for the exploratory research study. A research design can therefore be referred to as an overall plan for obtaining answers to research questions guiding the research study.

The present research study adopted a case study design which allowed the researcher to generate plausible information by observing young learners engaged in activities and observing teachers conducting mathematics lessons. This was done to establish how teachers nurtured critical thinking skills to improve mathematical literacy in young learners. Creswell (2013) regards a case study design as appropriate in situations where a single explanation cannot provide a complete account of the research since it provides up to date information, and this makes it suitable for the study of contemporary issues.

A case study is defined by Yin (2013, p. 13) as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context, when the boundaries between the phenomenon and the context are not clearly evident, and in which multiple sources of evidence are used." A case study design has been selected for this particular research because case study researchers spend a lot of time at the spot collecting extensive data. The present study used five schools to generate extensive data through observation of children engaged in activities, interviewing teachers and analysis of videos records captured during the teaching of mathematics to young learners.

Anney (2014) posits that case studies help researchers to gain insight into the context of the study thereby minimises the distortions of information that might arise. This could be so because researchers have extended time in the field which improves trust of respondents and provide a greater understanding of participants. In this particular context, the use of case studies provided the researcher with detailed information on how teachers teach critical thinking to improve mathematical literacy in young learners.

The case study design has been found fitting to this particular research study because five cases have been used in the research study. Roller and Lavrakas (2015) grants that the phenomenological researcher's central concern is that of returning to experiential meanings as dictated by the situation. For this research study, the settings are the selected five schools and the participants are teachers and young learners they teach. The use of qualitative methods enabled the researcher to focus on the dynamics of the teaching situation to get a deeper understanding of how teachers impart critical thinking skills to young learners to improve their mathematical literacy. The use of a case study of five schools therefore provided in-depth and interactive processes in the teaching of critical thinking skills to young learners to promote their mathematical literacy. This was found suitable since qualitative research focuses on specific and interesting cases emanating from direct source of data.

4.5 Data generation methods and techniques

Anney (2014) noted that triangulation involves the use of multiple data generation instruments, methods, sources or theories to obtain corroborating data. In addition, Yin (2013) believes that triangulation assists the researcher to reduce bias and to cross check participants' responses. In this research study, the researcher employed two triangulation techniques one of which made use of

the multiple researcher technique since an assistant researcher was engaged to capture videos during lesson observations, activity observations and interview sessions. Furthermore, data triangulation technique, that is, application of different data generation instruments, was also employed in this study.

Yin (2012) believes that the use of different sources, instruments and the number of schools may provide rigour in the research study because the greater the number the more replication and the greater the rigour. The use of triangulation of instruments in this research validates the results because this enabled the researcher to realise the credibility of the results

Observation guides were used to observe young learners as they engaged in activities as well as teachers as they taught mathematics to learners (3-8-year olds). The observation schedules were used to explore how teachers nurtured critical thinking skills to improve learners' mathematical literacy. Interview guides were also used to solicit data from teachers on their perceptions of teaching critical thinking to young learners and the factors they thought were related to the teaching of critical thinking skills. Additionally, teachers' responses were probed to explore why there was a need to impart critical thinking skills to young learners.

Data generation has been done in the form of structured interviews with early childhood development (ECD) teachers and video recordings of teachers conducting mathematics lessons or mathematical activities with learners in the3-8-year age range. Video recordings of young learners engaging in activities were also captured. An analysis of the video recordings was done as a reflective process for generating field notes to create a vivid picture of the lived experiences during data generation. The subsequent subheads focus on how different instruments used in the data generation process were administered.

4.5.1 Interviews

The present research study used structured interviews with a predetermined list of open-ended questions. Gary (2011) submits that a structured interview can be easily administered, and the responses easily coded. The use of in-depth interviews permits the researcher to obtain rich qualitative data which could not be acquired from observation alone. In the current research study, the researcher employed the use of open-ended questions in which each teacher was asked once while the assistant researcher was video recording the interactions. The videos recordings of the

interviews were meant to be analysed latter to solicit data on how teachers nurtured critical thinking skills in young learners to promote mathematical literacy during the teaching of mathematics (See Appendix B). In order to enhance the chances of obtaining rich data, participants were allowed to respond in any language they felt comfortable with. Cohen, Manion and Morrison (2011) admit that interviews with participants must be as explicit and as detailed as possible. The interviews lasted between 45 minutes to one hour. To avoid disturbing lessons, all interviews were conducted in the classrooms of the respective teachers after young learners had finished their lessons. The advantage of using interviews was that the researcher further probed respondents for more details based on each participant's response.

4.5.2 Observations

Mathematics lessons were observed and an observation guide with behaviour traits attributed to critical thinking was used right across all the age groups under study (see Appendix C).Learners' actions were recorded and the actions done by teachers to support their charges were also noted. Gary (2011) suggests that the distinct feature of observation as a research process is its provision for an opportunity for the researcher to generate first-hand information from naturally occurring social situations. Videos recording and observations were recorded within a period of five weeks starting from school A to school F during the teaching of mathematics. Data was collected though interviewing, observing teachers teaching mathematics and observing the 3-4-year age group (ECD A), 4-5-year age group (ECD B), 6year olds (grade 1), 7-year olds (grade 2) and eight-year olds (grade 3) at each of the five schools. One week was spent on each of the five schools to make a total of five weeks of data collection. Cohen and Manion (2011) believe that, through observations, the researcher directly obtains what happens at the scene rather than relying on second-hand accounts.

Another observation guide was employed to observe young learners as they interacted and engaged in activities (Appendix D). The young learners were observed while engaging in mathematical activities in groups ranging from 3 to 13 members per group to explore the critical thinking skills involved in what they said and what they did. Characteristics of critical thinking were recorded. The young learners were observed while they were engaged in activities in groups since the present research study is hinged on social constructivism. Sohel (2012) argues that young learners are usually observed when they are involved in their everyday activities but there may be occasions

when there is need to set up specific activities to support specific observations. In this research study, observing young learners assisted the researcher to observe behaviours that might otherwise not been seen by merely observing teachers or by interviewing them. To make the best of learners' observations, a systematic approach to observing each learner was ideal. Therefore, observations were deemed suitable for this research study because they assisted in gathering first-hand data. This was done by directly observing how teachers stimulated critical thinking skills in learners and how learners acquired critical thinking skills as they engaged in their activities.

4.6 Trustworthiness

In this research study, the researcher established rigour of her inquiry through a triangulation of methods and instruments. Further trustworthiness was established through field experiences where the researcher observed mathematics lessons, learners engaged in activities, and conducted interviews with ECD teachers. Field observations, interviews and video recording were used to generate data. Anney (2014, p. 277) proposes that, "Triangulation involves the use of multiple and different methods, investigations, sources and theories to obtain corroborating evidence." By using multiple data collection strategies as data gathering instruments, the researcher enhances the trustworthiness of the study. Observing each teacher once and video recording once per teacher could be factors militating against the trustworthiness of the study, and influencing the extent to which the sample is representative of the whole population.

To ensure trustworthiness and consistency, a pilot testing of the instruments was done to confirm whether the data generation may be repeated with the same results. The researcher was assured of accurate results because she was on the ground generating data through interrogating participants. Thick descriptions of what was taking place were noted through viewing the video recordings numerous times to transcribe the data.

Credibility is also assured in this qualitative research because of the field notes that the researcher obtained through interviews, observations, video recordings and analysis of the video recordings and transcribing of interviews. According to Yin (2012), credibility can be enhanced if the researcher obtains detailed field notes by employing a good quality video or audio recorder for recording and by transcribing the recordings. Likewise, the use of video recordings in the present research study took the same position in matters of credibility.

To ensure transferability in this research study, the researcher recorded videos during lesson observations and interviews which were played latter while transcribed thick descriptive data. This allowed for a comparison of contexts, for example, comparison of contexts of different schools under study. Dependability is said to involve participants evaluating the findings and interpretation and recommendation of the research study to make sure that they are all supported by the data received from informants of the research study (Cohen, Manion & Morrison, 2011).To address dependability in the study, thorough observation of teachers teaching mathematics and observation of learners was done right across all the age groups under study. Raw data on video records is kept in an external hard drive, and observation notes for both lesson observations and learners engaged in activities are securely kept by the researcher.

4.7 The pilot study

Creswell (2014) avers that a pilot study is used as feasibility study to ensure that ideas or methods behind research are sound. Pilot studies are therefore critical in descriptive surveys because they assist the researcher to ascertain the feasibility of the research study. In the current research study, pilot testing was done to test the feasibility of the interview and observation guides intended for the main research study. Results of the pilot study assisted the researcher in the current research study to ascertain the suitability of observation instruments for teachers and learners, as well as the interview guides. Hadwen (2014) observes that a pilot study is a smaller version of a larger research study and is conducted to prepare for the major research study. Check, Russell and Schult (2012)) admit that pilot testing enables the researcher to make alterations in the data collection process so that the data of the main research study may be analysed more efficiently. Several alterations were made and ambiguities in questions were corrected in the current research study as a result of pilot testing each research instrument

A pilot sample similar to one fifth of the main sample was used because only one school was used in the pilot study to represent the five schools in the main study. Five ECD teachers in ECD A, ECD B, grade 1, grade 2 and grade 3 were chosen to participate in the pilot study at a Central Practicing School which is part of the college training ground were students are deployed for teaching practice. All interviews and observations were conducted and video recorded by the researcher. Additionally, an opportunity to make contributions to the research instruments and

modifications was granted to respondents during pilot testing. Participants' comments and contributions led to modification of question structures before the main study commenced.

Due to the pilot study results, the researcher noted that it was necessary to engage a qualified photographer to record all the video recordings during the teaching of mathematics and during learners' activities as well as during interviews. It was noted during pilot testing that all video recordings conducted by the researcher were not audible enough, especially the responses by participants during lesson observations, observation of learners engaged in activities and during in-depth interviews. Only the voice of the researcher could be clearly heard since she was the one holding the recording device. The results of the pilot study also revealed that videos recorded by the researcher had blurred pictures because the researcher's movements from point A to point B disturbed the images of the recordings and actual lesson activities in particular. The remedy for the identified challenge was to engage a qualified photographer to do all the video recordings for the main research study. Interview questions were also adjusted so that they could be clearly understood by respondents. Creswell (2013) grants that a pilot study provides a researcher with an opportunity to discover ideas that he or she may not foresee before conducting the pilot study.

The results of the pilot study also revealed that resorting to obtaining responses in English restricted the quantity and quality of the data participants provided because very short responses were given. In the main study the researcher encouraged respondents to use any language they felt comfortable with, and this was transcribed and translated into English at a later stage. The subsequent section provides a discussion of the sampling process used for the main study.

4.8 Population

Yin (2012) describes 'population' as a group of people who are participating in the study and to which the results would apply. The population can therefore be taken as a group to which a researcher makes inferences from and usually it comprises people of same characteristics. The population for this research study is made up of all early childhood teachers (approximately 250), and all early childhood learners in the 3-8-year age range (approximately 10 000) from all primary schools under the Ministry of Education Sport and Culture in Zaka District. Early childhood teachers have been selected for this research study because they are the ones who work with learners in the 3-8-year age bracket. The population was drawn from ECD teachers in Zaka District primary schools and all young learners they teach.

4.9 Sample and sampling procedures

A sample is a sub-set of the whole population under study (Yin, 2012). As Creswell (2014) avers, an entire population tends to be too large to work with, thus a smaller group of participants must act as a representative sample. To generalise research results with accuracy and precision, researchers should carefully select the samples for their studies (Cohen & Manion, 2011). In the current research study, the researcher sought to select a sample that was a true representative of the population in order to use the results obtained from the sample to generalise about the entire population. Gary (2011) argues that a sample should be carefully chosen such that, through it, the researcher is able to see all the characteristics of the total population in the same relationship that would be seen by examining the entire population.

Of all the primary schools in Zaka District, only five schools had been selected through convenience sampling. The researcher made a list of all schools in the district that were convenient to her. Cohen and Manion (2011, p. 143) believe that, "Factors such as experience, time and accessibility frequently prevent researchers from gaining information from the whole population." Systematic sampling procedure was then used to select every fifth school on the list. The procedure gave all the convenient schools an equal opportunity of being selected. The researcher considered that this may give her the opportunity to frequently visit the schools when she goes out on teaching practice supervision.

The sampling procedure is convenient because this strategy can be an excellent means of obtaining preliminary information during teaching practice about the situation in schools and how best to carry out some observations, interviews or document analysis during the actual data generation process. According to Yin (2014), convenience sampling refers to the selection of those cases that are easiest to access under the given conditions. The study sample consisted of twenty-five ECD teachers in the selected five schools and young learners they teach.

4.10 Data collection procedures

The first instrument that the researcher administered is an observation guide (Appendix A). The observational method has been found suitable for this case study because it assists the researcher to cross check data and improve its authenticity. Behaviour traits involved in critical thinking were observed during the teaching of mathematics to young learners. Thus, learners' actions as well as the support given to stimulate critical thinking skills by teachers were recorded. In qualitative

research, observation is concerned more with how behaviours of participants are performed in relation to enhancing or acquiring critical thinking skills. At the end of the observation period, semi-structured interviews were conducted with the teachers of young learners. The interview guide (Appendix B) was employed for in-depth interviews with teachers. The semi-structured interviews provided participants with an opportunity to answer the same questions, thus increasing comparability of data on the questions addressed.

A semi-structured interview (Appendix B) in which the observer organised content and procedures prior to the interview was used. Every necessary detail, for example, wording of questions, sequence of questions and timing of the interview, was scheduled in advance. An observation guide (Appendix D) was used to establish how critical thinking skills were stimulated as young learners were engaged in activities. Video recording was done to capture the teaching of mathematics and/ or mathematical activities. These recordings are documentary evidence with the focus on the learner and the critical thinking skills nurtured during mathematics teaching. Yin (2012) maintains that researchers should aim for rich descriptions of a phenomenon within its real-world context. The use of recorded videos for the three instruments were therefore used as documentary evidence in which transcriptions were done to assist the researcher in defining the features of learners' critical thinking skills in real mathematics teaching and learning contexts.

4.11 Data presentation and analysis

The bulk of data that the researcher collected were first observations, then interviews and documents which were later transcribed. For interviews, the researcher started by transcribing the responses, and then translated the responses that were given in vernacular. For observations and video records, thick descriptions were written. The researcher then analysed the data through the content Johnson-Christen method in which the data were coded, segmented and grouped in thematic units. Analysis of comprehensive data in this research study was through examining recurring instances that the researcher identified and grouped and presented thematically. In the present research study, the researcher divided data into meaningful analytic units by reading transcribed data repeatedly to develop themes. According to Cohen and Manion (2011), data analysis relies on coding to identify themes and concepts that are in the transcribed data. Similarly, Yin (2014) believes that, as analysis progresses, it becomes apparent that many concepts are related, and these are classified into themes or groups. The researcher presented transcriptions in

a systematic way and in narrative form. Analysis and presentation in this form assisted the researcher to deduce issues related to the teaching of critical thinking skills to promote mathematical literacy with young learners because the interpretation process continued while cross analysing and sorting themes and excerpts in narrative form.

4.12 Ethical issues

Ethics is used in research to judge behaviours or guide individuals to make decisions when there is a moral question of whether an action is right or wrong (Creswell, 2014).Based on the preceding standpoint in research ethics, the researcher has the responsibility to make sure that participants are not harmed in any way by participating in the research. Yin (2012) is of the idea that the main ethical considerations involving participants in research may include avoiding causing harm to them, maintaining their privacy, anonymity, confidentiality and allowing them to exercise informed consent. The researcher was aware of the University of KwaZulu-Natal's Research Ethics Policy and complied with the University's "Code of Conduct for Research" in addressing ethical issues while carrying out this research study. Additionally, the researcher ensured that the rights and welfare of all research participants were observed, respected and protected. The subsequent ethical standards were adhered to ensure that participants were protected from harm during and after the research process.

4.12.1 Permission

Researchers ought to secure approval to conduct research in schools or approval of research participants before embarking on an investigation or exploration (Creswell, 2014). The researcher sought the approval to carry out this particular research study, first, by seeking ethical clearance from the University of KwaZulu-Natal. The ethical clearance from the university enabled the researcher to seek permission from the Ministry of Primary and Secondary Education, starting from Head Office in Harare to Provincial Office in Masvingo and, finally, the District Office in Zaka, to carry out the research study in schools. The researcher also sought approval from research participants through consent letters. Consent forms for relevant gatekeepers are found in the appendices (See Appendix H.).

4.12.2 Informed consent

Check, Russell and Schult (2012) admit that researchers need to secure the approval of research participants prior to conducting their studies. Appropriate conduct should be assured and the basis

for trust should be established between researchers and participants. Creswell (2013) is of the view that whenever researchers conduct research, the people's well-being should be the first priority. Thus, informed consent is one of the crucial tools for ensuring respect for research participants. In this research study, participants for both the pilot study and the main research study were given informed consent letters that stipulate the purpose of the research study and assuring them of confidentiality, anonymity and protection from harm and emphasising that there were no financial benefits involved in the research study. Written consent forms were used to seek the consent of teachers while oral consent, though documented, were used to seek permission from parents and guardians to work with their children. Yin (2013) asserts that, with oral consent, a person may receive all the information needed for consent either verbally or in writing and the verbally consent to participate. It is imperative for a researcher to ensure that people involved in the research study understand the purpose of the research for participants to consciously decide if they want to participate. The participants in this research study had to indicate on the space provided on the consent letter by ticking whether they were willing to allow observations and interviews to be recorded by audio equipment, photographic equipment and video equipment. Since the researcher was dealing with minors, consent letters for parents or guardians were administered as verbal consents to seek authority to work with the minors. The researcher achieved consent of the minor's parents and guardians by informing them about the research study in a way they easily understood and, as such, no parent gave an objection to the consent.

4.12.3 Confidentiality

Creswell (2013) admits that confidentiality connotes ethical obligation of the researchers to keep the identity and responses of the research participant private. Thus, any researcher should have the obligation to respect the right to confidentiality of research participants. Yin (2013) submits that anonymity is one way in which confidentiality is maintained. Confidentiality of participants in the present research study was taken into consideration by ensuring that names of schools, teachers and learners were kept anonymous by using codes or pseudonyms in place of the actual names.

4.12.4 Anonymity

Anonymity in the research study is realised when a researcher cannot associate a given response with a given respondent. Arthur, Waring Coe and Hedge (2012) and Creswell (2014) concur that the ethical responsibility of the researcher is to respect the right to anonymity of research

participants. Anonymity or confidentiality has been preserved by using codes for all names including those of schools, teachers and learners. Yin (2013) is of the view that anonymity of a study is realised when no one can associate a given response with a given respondent. Anonymity in this study was also assured by presenting responses in thematic groups rather than as individual responses. Thus, the report of the present research study has been presented in such a way that people are unaware of how different participants responded to interviews or who was observed and recorded. Name of participants were not written on instrumentation to keep their identity private. After the data was analysed, all participants were invited to an interactive workshop where the researcher disseminated the findings of the research study to participants.

4.12.5 Protection from harm

In the current research study, participants were assured of protection from harm such as damage to personal dignity, labelling, embarrassment, physical, emotional, social or harm of any nature. Cohen and Manion (2011) agree that researchers should not expose research participants to unnecessary physical or psychological harm. Psychological harm in the present research study has been neutralised by ensuring confidentiality and anonymity and by not asking sensitive questions which might have caused psychological effects.

4.13 Conclusion

This chapter has presented and discussed the research methodology employed for this research study. The aspects covered include qualitative research design, instrumentation, trustworthiness, pilot testing, main study sample, sample and sampling procedures, data collection procedure, data presentation and analysis and ethical issues. The next chapter presents and analyses the generated data

CHAPTER 5: DATA PRESENTATION AND ANALYSIS

5.1 Introduction

The aim of the present research study was to explore the teaching of critical thinking skills during mathematics lessons with the aim of promoting mathematical literacy of learners in the 3-8-year age bracket. Unlike in South Africa where mathematical literacy is a specific subject, in Zimbabwe it is not a standalone subject, but mathematical literacy may be acquired during mathematics teaching. The previous chapter presented the research methodology and several aspects have been covered that include the qualitative research approach, instrumentation, trustworthiness, pilot testing of the research instruments, selection of participants, sampling procedures, data collection procedures, data analysis and ethical issues. In this chapter, the data generated through interviews, observations and document analysis (videos clips) are presented and analysed. Interpretation of data from interviews and observations was done through linking related issues or identifying similarities in the responses given by the twenty-five teachers or observed from their teaching or learner activities. Excerpts drawn from responses or observations made are presented verbatim under the different themes that emerged from issues raised.

5.2 Presentation of data under themes drawn from responses by teachers, lesson observations and the observations of learners engaged in activities

Twenty-five teachers of young learners in the 3-8-year age range were asked to share their views on what they consider as factors influencing their teaching of critical thinking skills to young learners. From their responses, themes where drawn from related excerpts given by teachers in response to interview questions. In soliciting factors related to the teaching of critical thinking skills to young learners, age emerged as a factor related to the teaching of critical thinking skills. Data in which young learners were observed engaging in mathematical activities are also presented.

5.2.1 Age as a factor related to the teaching of critical thinking skills to young learners

The present research study revealed that age is a factor related to the teaching of critical thinking skills to young learners. The factors that are age-related include chronological age and mental age.

Table 5.1: Observation of ECDA Learners (3-4-year olds) engaged in mathematical activities

Name of activity	Number of learners	Materials used	Behaviour(s) exhibited by young learners
Sorting leaves	6-8 per group	Trees of different local trees	One group heaped all the leaves instead of sorting those of the same tree.
Counting	Individually	Bottles tops, chalkboard illustrations	Hid one of the bottle tops when noted that the teacher was coming when he had more than the required 3 bottle tops
Sorting by shape	3-4 per group	Blocks of different colours	On being given the blocks one child rushed to do the sorting before instruction. The teacher shouted "*ibvapo iwe garapasi"* Meaning "you get away from there, sit down.
Sorting by colour	4 per group	Bottle tops, blocks colours	One boy started singing colours, colours, while sorting
Identifying shapes	4 per group	Shapes in different colours and sizes	One girl rushed to the teacher without being called to identify the shapes.

Observation of the 3-4-year olds indicates the young learners' behaviours during mathematical activities do not explicitly display critical thinking skills but the behaviours shown could have involved critical thinking of some sought. Most activities show a reasonable number of learners in a group, which could have assisted one another during the mathematical activities and by extension resulting in explicitly displaying critical thinking skills. No technological learning resources were involved right across the activities observed among the 3-4-year olds.

Table 5.2: Observation of ECD B Learners (4-5-year olds) engaged in activities

Name of activity	Number of learners	Materials used	Behaviour(s) exhibited by young learners
Colouring similar shapes	5-9 per group	Work cards with shapes and crayons	Told a peer "*Apa colour mukati"* Here colour inside.
Sorting by colour	3-6 per group	Shapes in different colours	One of the learners was observed sorting shapes with different shapes even those with different colours.
Sorting by number of items	3-4 per group	Cards with the shapes ranging from1-4	One learner corrected her group member when he combined a card with 4 elements with those with three elements
Identifying shapes	3 per group	Shapes in different colours , matching shapes	One child commented this shape is like a dollar
Counting to five	Individually	Blocks of different colours and sizes	One child started constructing instead of counting the blocks

Observation of the 4-5-year olds, just like that of the 3-4-year olds, does not explicitly show critical thinking skills involved as children engaged in activities. The behaviour exhibited could have resulted from thinking critically before displaying the behaviour. In line with the tenets of social constructivism, the learners were in groups of 3 to 9 learners except in one occasion where learners were working individually. Just like for the 3-4-year olds, no technological resources or tools were provided for children to utilise as they carried out the activities.

Table 5.3: Observation of Grade 1 Learners (6-year olds) engaged in activities

Name of activity	**Number of learners**	**Materials used**	**Behaviour(s) exhibited by young learners**
Number tens	4 per group	Number line, work Cards of sets	Counting using the number line before instruction. Learners speaking in very low voices
Subtraction to 5	2-4 per group	Work cards ,stones	*"Duster iro" "*Meaning there is the duster" *:* shouting at the teacher when he showed that he was looking for something
Subtraction	3-6 per group	Counters, work cards	"*Ndiyo here ndinyore answer*? "asking group members. Meaning "should I write if it is the correct answer?" and shouted "*Tawana 12 pana 20"* Meaning "we got 12 by counting back from 20"
Subtraction by counting back	5-8 per group	Number line, Work cards, counters	One group quickly worked out their problem while talking in low voices.
Finding the missing numbers	4-5 per group	Work cards ,counters	On solving the problem 8 + □ = 9 one child counted 9 stones subtracted 8 stones and said "*ndiyo answer"* Meaning "that's the answer"

Observation of the 6-year olds indicates some improvement in terms or speaking of talking during the teaching of mathematics. In some instances young learners asked for opinions from fellow group members. Even though some cultural behaviour traits were diminishing, no critical thinking skills were explicitly displayed by learners during the teaching of mathematics.

Table 5.4: Observation of Grade 2 Learners (7-year olds) engaged in activities

Name of activity	Number of learners	Materials used	Behaviour(s) exhibited by young learners
Sets of 4	3 per group	pieces of paper, work cards	Learners were whispering to one another
Fractions	10-11 per group	bottle tops, work cards	One child, who initial had 6 counters, just added 2 counters on instruction that they should now take 8. -Some learners first returned the 6 and started counting the 8
Sets of 0-10	4-5 per group	Number line only	Where whispering as they work. Critical thinking behaviours not evident
Sorting	individually	Shapes of different colours and sizes	Most learners where seen silently grouping those with the same colour. Two learners were grouping those of the same size without considering the colour.
Sets of 2	4-5 per group	Marula seeds and work cards	One girl whispered "*ndisikisi"* Meaning "its 6 "

Observation of the 7-year olds indicates that, in some instances, young learners were whispering or carrying out their tasks silently. Whispering is accredited to the kind of socialisation young learners received from their homes or from their teachers. One of the socialised behaviours noted could be restricted talking in which learners were always called to silence or asked not to make noise. The resources provided exclude technological resources. The number of group members gave room for social interaction and scaffolding by peers.

Table 5.5: Observation of Grade 3 Learners (8-year olds) engaged in mathematical activities

Name of activity	**Number of learners**	**Materials used**	**Behaviour(s) exhibited by young learners**
Multiplication using ready reckoners	As a class	Number line, work cards of sets	The ready reckoner had no slot for the night but the child got $19 since she added $10 for working in the morning and $9 for working in the afternoon.
Sharing	8-13 per group	Work cards, stones	One child encouraged " *Taurisa"* Meaning "speak up to a colleague who was giving an answer
Multiplication	5-7 per group	Counters, work cards	Asking a colleague "*Vana 7 vangani?* Meaning how many sevens? The other one shouted where did you get this 4? Answered "*Tataimuzakutitiwane answer*." Meaning " we have multiplied to get an answer"
Subtraction by borrowing	2-5 per group	Number line, work cards, counters	One child said " 3-5 it can't
Multiplication without carrying	4-5 per group	Work cards, counters	When one child was asked to work out 22 *5 He thought of engaging the class and asked, "What is 2*5?" Some learners were whispering in their groups.

Observation of the 8-year olds revealed emergence of some traces of criticality. It appeared the cultural behaviour traits were fading away. In some cases learners could be heard freely taking, asking questions, making inferences and making decisions. Some characteristics of critical thinking displayed could be likened to diminishing culturally related behaviours of young learners during the teaching of mathematics. No technological tools were provided right across all activities observed among the 8-year olds.

5.2.1.1 Chronological age as a factor related to the teaching of critical thinking skills to young learners

The participants indicated that age is a factor that influences the teaching of critical skills to young learners. Chronological age as a factor that contributes to the development of critical thinking skills in young learners has been drawn as a theme emerging from the following excerpts from interview transcripts:

> Teacher 1: …*young learners think very much*….
>
> Teacher 2: …*failing to answer questions that are not age appropriate*…
>
> Teacher 3: …*ECD A learners need critical thinking to tackle ECD B level questions*…
>
> Teacher 4: …*learners below age 3 not able to perform certain skills for the 4-5-year olds*…
>
> Teacher 5: …*those fairly grown up are at an advantage*…
>
> Teachers 6: …*give ECD A learners' work within their capacity and increase the matter with* age...
>
> Teacher 7: …*asking questions within the learner's level*…
>
> Teacher 8: …*learners who are fairly grown up think like adults*…

The transcript data drawn from the interviews reveal that some teachers believe critical thinking comes about as the child grows chronologically. The teachers' responses converge with findings made through observing children engaged in activities. The data from observations indicate that ECD A learners display limited characteristics of critical thinking less than Grade 3 learners. Chronological age of young learners is therefore likely to influence the development of critical

thinking skills. The increasing characteristics of critical thinking are accredited to the diminishing cultural traits which stifle the development of critical thinking.

5.2.1.2 Mental age as a factor related to the teaching of critical thinking skills to young learners

The interviewees also indicate that mental age, like chronological age, is related to teaching young learners' critical thinking skills. Data from in-depth interviews also indicate that mental age is related to the teaching of critical thinking skills to young learners. A theme indicating that mental age relates to the acquisition of critical thinking skills has been drawn from responses given by teachers of young learners. This is corroborated by the following extracts from interview transcripts:

> Teacher 9: …*affects the child when given what is above his/her level…*
>
> Teacher 10*: …schools enrolling learners of age 6…*
>
> Teacher 11*: … not grasping concepts in 30 minutes time…*
>
> Teacher 12*: …language used not consistent with the age level…*
>
> Teacher 13*: …some of the matter too difficult for learners to tackle…*
>
> Teacher 14*: …learners at lower levels failing to grasp concepts…*
>
> Teacher 15*: …some of the skills not suitable for the age level some concepts too high for the child's level…*

The excerpts indicate that young learners are capable of thinking critically as long as the work is within their developmental level. The presented data from observing young learners engaged in activities indicates that, as young learners grow or develop, the cultural behaviour traits which may stifle the development of critical thinking skills fade away. Young learners are therefore likely to be assisted to think critically in developmentally appropriate learning environments if provision of instruction considers age levels.

5.2.2Cultural factors

Several factors have been found to be related to the teaching of critical thinking skills. The cultural factors appear as if they are a major setback in the development of critical thinking skills in young children during mathematics teaching.

Table 5.6: Teaching culture that may stifle development of critical thinking skills in young learners during mathematics teaching

Grade/level	Behaviour(s) captured	Cultural traits emerging
ECD A 3-4 years	Teacher: "*I don't want a person who does what I have not told him to*)."	Young learners are not allowed to make decisions.
ECD A 4-5 years	Teacher: "*Now let us count 10 counters*." Learners: Started counting in chorus, some clicking their fingers "*Me teacher! Me teacher*!" Teacher: "*What happened there*?"	Some behaviours by young learners are thwarted at any early age.
Grade 1 6 years	Teacher: Distributed exercise books and asked, *"Who does not have a book?*" Learners: Kept quiet Teacher: Walked to learner who did not have a book and said: "*You! Speak! Don't you have a mouth?*"	Young learners sometimes are humiliated during the teaching of mathematics.
Grade 2 7 years	Learners: Busy discussing in low voices. Teacher: Shouted, "*What is the problem there*?" Learners: There was silence. Teacher: "*Can't you hear me*?" Learner: One replied hesitantly, "*I have no book."* Teacher: "*Why didn't you say this earlier on? Who said I have no book? Here it is*."	Young learners are not expected to discuss while carrying out other tasks. Young learners end up not very sure of what to do as they are advised to be quiet in some instance while they are forced to speak out in another.
Grade 3 8 years	Teacher: "*Close your books put them aside and listen. Stop writing and close your books*." Learner: Coughing and sneezing and no talking.	Young children have to abide by what adults say

Cultural factors, both on the part of the teacher and the young learner, appear to greatly influence the development of critical thinking skills right across all age groups under study. The teaching

culture of some teachers, which might also be a result of their cultural influence, may impede the development of critical thinking skills in young learners. The data indicates that teachers usually forbid young learners to talk during mathematics teaching and encourage them to speak out in another moment when responding to questions or when sharing ideas in groups. The data also displays the teacher's authority over young learner which may extend to fear of the teacher. Fear does not give young learners room for critical thinking. Basing on the social constructivist epistemology which guides the current research study, learners are expected to learn as they freely interact with the teacher or amongst themselves. Restricted talking may extend to young learners' failure to think critically, ask questions, give opinions or solve problems. The observed culture of humiliating learners instead of encouraging them may also have a bearing on their development of critical thinking skills. Some teachers could be heard addressing learners using a humiliating tone, for example, *"You! Speak! Don't you have a mouth?*" or "*Can't you hear me*?" The kind of talking may completely shatter the capability of critical thinking in young learners.

5.2.2.1 Adult influence as a cultural factor in the teaching of critical thinking skills to young learners

The participants in this research study pointed out some of the cultural factors that influence the teaching of critical thinking skills to young learners. The following excerpts show some of the teachers' views on adults as an influence on the teaching of critical thinking skills to young learners:

> Teacher 16*: …no opportunity given to learners to think critically…*
>
> Teacher 17*: …everything is done for the learners even self-help routines…*
>
> Teacher 18*: …child already affected by upbringing when he/she joins school…*
>
> Teacher 19*: …learners not exposed to things that enhance critical thinking skills…*

The preceding data indicates that young learners are greatly influenced by their elders such that they are left with no option except to conform to their expectations. The given excerpts reveal that young learners have no freedom to decide or give opinions but conform to what adults say. The data from observations converge with the excerpts drawn from interviews since a considerable number of teachers were observed forbidding learners to talk during the teaching of mathematics.

It is likely that the upbringing of a learner, where the learner has to conform to what adults expect, may stifle the development of critical thinking skills.

5.2.2.2 Community influence as a cultural factor related to teaching learners critical thinking skills

The data generated through observing the teaching of mathematics to young learners appears to be a reflection of the expectations of the community. Conformity of young learners seems to be emphasised particularly in restricting learners to talk. It has also been drawn from the following interview transcripts that cultural traits in the community are a setback to learners' development of critical thinking skills:

> Teacher 21: …*some of the things not allowed in that particular culture…*
>
> Teacher 22: *…may face problems on joining a new culture (school)…*
>
> Teacher 23*: …start seeing some of the things at school…*
>
> Teacher 24: *…some customs not going in what is found in the child's culture…*

Data from interviews indicate that teachers consider what the community expects of learners and tend to respect what is within a culture in teaching young learners. The views given indicate that some expectations of the community may stifle learners' critical thinking skills. Young learners may religiously follow what the community expects of them without considering other options. An example can be drawn from observations made where one of the teachers said, "*I don't want a person who does what I have not told him to*". Under such cultural restrictions, a learner is restrained from thinking for himself or herself. The opportunities for thinking critically are therefore compromised. Given such cultural background, the development of critical thinking skills in young learners maybe heavily influenced by the context in which learners are raised and how they were socialised. The next section focuses on learners' backgrounds and the influence of background factors on the teaching of critical thinking skills to young learners during the teaching of mathematics.

5.2.3Background factors

The present research study also noted several background factors that are related to the teaching of critical thinking skills to young learners. The factors identified include technological, economic status, intellectual support, emotional support, reinforcement of schoolwork and gender.

5.2.3.1 Technological influence as a background factor related to the teaching of critical thinking skills to young learners

Experience in working in the contemporary world has shown that information and communication technology (ICT) is significantly enhancing and altering human activities, enabling people to live, work and think in ways that most of us never thought possible. The following are excerpts showing technological influences on the development of critical thinking skills in young learners:

> Teacher 1: …*some of the learners watch television and use computers…*
>
> Teacher 5*: …others become surprised on seeing a computer…*
>
> Teacher 9*: …some learners come from homes where there is no technology…*
>
> Teacher 10: *…some learners are used to operate technological gadgets when doing mathematics…*
>
> Teacher 13: *…teachers resort to using counters instead of technological tools…*

The preceding interview transcripts reveal that lack of technological resources influence the development of critical thinking skills in young learners. Some participants indicated that some learners come from backgrounds who cannot afford ICT gadgets while others come from families who have acquired and use such electronic devices. The excerpts from interview transcripts indicate that technology is a factor related to the development of critical thinking skills in learners. Some of the excerpts also reveal the importance of electronic teaching resources in nurturing critical thinking skills in young learners. Despite being in the era of technological advancement, where electronic gadgets should be at the fore in fostering critical thinking skills in the young generation, only work cards were commonly used as learning resources in most of the mathematics lessons observed. Diverging from the necessity of technological resources in teaching, the observations made during activities or lessons revealed that teachers did not provide technological resources in the teaching of mathematics to stimulate learners' critical thinking skills in order to

improve mathematical literacy. This is exemplified in the presented data where younger learners were engaged in activities. Data analysis revealed that teachers did not provide technological tools which may have created an opportunity for young learners to think critically. The teachers resorted to provision of work cards, number lines and counters right across the age levels under study. Based on the responses from in-depth interviews and observations made by the researcher, lack of technology in teaching young learners deprived them of thinking critically. Critical thinking related behaviours observed during mathematics lessons or activities were limited showing that the kind of resources used did very little to stimulate learners' critical thinking. It is most likely that such learners may be found at a lower level of criticality as compared to their counterparts in the same age bracket where technological tools have been introduced in their mathematical activities. Inversely, the lack of technology in some young learners' home backgrounds as well as lack of technological tools in the teaching of mathematics stifles their critical thinking skills.

5.2.3.2 The socio-economic status of parents as a background factor related to the teaching of critical thinking skills to young learners

The socio-economic status of parents has been noted as having a negative impact on learners' acquisition of critical thinking skills. This is corroborated by the following excerpts from interview transcripts:

> Teacher 14*: …lack of stationery…*
>
> Teacher 15*: …lack of exposure to certain objects or environments…*
>
> Teacher 17: *…meeting new things at school…*
>
> Teacher 18*: …failing to grasp concepts due to daydreaming…*
>
> Teacher 19: *…coming to school on an empty stomach…*

Excerpts drawn from in-depth interviews indicate that lack of material resources has a negative effect on the learner's critical thinking skills. The learner's family background experiences and the socio-economic status of parents were said to have an influence on their learning and development of critical thinking skills. The present research study observed that some parents could not afford to provide adequate stationery for learners to actively participate in the learning of mathematics.

This is reflected in the views provided by teachers of young learners during in-depth interviews. The teachers indicated that the availability of resources depends on the learner's background since. They noted that some learners came to school without books or pencils and even without eating. In the observations of mathematics lessons, one learner who was not writing gave a reply to the teacher hesitantly, "*I have no book."* In extension, anything that disturbs a young learner may create less opportunity for the development of critical thinking skills. It is most likely that availability of resources in the homes may create opportunities for stimulation of critical thinking skills in young learners. Learners do not develop critical thinking skills in a vacuum, they have to interact with learning tools both at home and school for them to be stimulated to think critically.

5.2.3.3 Offering intellectual support as a background factor related to the teaching of critical thinking skills to young learners

Additionally, excerpts from interview transcripts show that intellectual support is related to the teaching of critical thinking skills to young learners. The subsequent excerpts indicate that learners' critical thinking skills can be inhibited by lack of support from adults as well as their poor socio-economic status. One of the responses given indicates that learners can think critically despite coming from families of poor economic status quo. A theme drawn from the following interview transcripts reveal that lack of intellectual support may stifle learners' critical thinking skills.

> Teacher 22: …*learners not having opportunity to say what they want…*
>
> Teacher 24*: …some parents suppress learner's ideas…*
>
> Teacher 25*: …learners having different situations they come* across…

From the sentiments above, families and teachers who offer intellectual support are likely to foster learners' critical thinking skills during the teaching of mathematics. This is irrespective of whether learners come from poverty-stricken backgrounds or not. Observations made during the teaching of mathematics show that young learners can be supported intellectually through probing them to think.

Teacher: "*How are we going to get the middle number?"*

Learner: "*We use the number line*."

Teacher: "*How, class*?"

Probing learners to go further than the superficial answer creates opportunities for young learners to stimulate their minds which may result in critical thinking. Young learners need scaffolding in terms of intellectual support for them to think critically.

5.2.3.4 Offering emotional support as a background factor related to the teaching of critical thinking skills to young learners

The lack of emotional support was noted to be a hindrance in young learners' development of critical thinking skills. The subsequent interview transcripts indicate that critical thinking is likely to be inhibited in young learners who are not in emotionally supportive environments:

Teacher 4*: …looking down upon himself or herself…*

Teacher 5*: …learners from poor backgrounds may be fearful…*

Teacher 6*: …reluctant to play because he/she comes from a poor background…*

Teacher 9*: …a child from a poor background lacks self-esteem…*

Teacher 10*: …learners from better family backgrounds are motivated…*

Teacher 11*: …some learners stay in very remote areas where there are no much things to stimulate critical thinking…*

The preceding transcripts reflect that young learners learn better if they are in a good emotional state. The participants also reveal that early experiences have a direct impact on how young learners develop learning skills as well as social-emotional abilities. Emotional support offered by teachers to young learners during mathematics teaching is related to the teaching of critical thinking skills. If young learners are supported by their teachers during mathematics teaching, their critical thinking skills are likely to be stimulated. The presented excerpts from interviews display a child lacking confidence, who is fearful, not highly motivated and has a low self-esteem. Young learners characterised by such cultural behaviour traits find themselves reluctant to answer

questions or ask questions and, by extension, leading to their failure to think critically. The kind of young learners shown need emotional support from their teachers to stimulate their critical thinking skills. This is exemplified by what obtained through video analysis.

Table 5.7:Cultural behaviour traits that may stifle the development of critical thinking skills in young learners

Grade/level	Behaviour(s) captured	Culturally related aspect(s) emerging
ECD A 3-4 years	Teacher: "*You are not speaking; speak out the issues while you find where to place each of the items. I want to hear you speaking, speak, speak*."	Socialised not to speak in the presence of adults
ECD B 4-5 years	Teacher: "*Speak loudly. What shape is this*?"	Socialised not to speak in the presence of adults.
Grade 1 6 years	Teacher: "*You are not speaking; you count while speaking. Speak up, and you are just quiet with stones in your hands. Count, speak up*." Teacher: To the rest of the class, "*Let us be quiet*."	Young learners normally get confused on what really to do. In one moment they should speak while they should be quiet in another.
Grade 2 7 years	Teacher: "*Someone to help her; she is not speaking loudly."*	Socialised not to speak in the presence of many people.
Grade 3 8 years	Teacher: "*Don't hide your face. Someone to help him."* Learner: Kept quiet not responding to the question only gazing at the floor.	Young children are shy to speak while other people are looking and listening to them.

Some cultural behaviour traits appear to interfere in the teaching and learning of young learners. Young learners who lack confidence, who are shy to speak need scaffolding during mathematics teaching for them to develop critical thinking skills. This can be done by allowing learners to assist one another by working in groups and encouraging them to make constructive noise. Young learners cannot be expected to think critically when they play a passive role during mathematics teaching.

5.2.3.5 Reinforcement of schoolwork as a background factor related to the teaching of critical thinking skills to young learners

Responses drawn from interview transcripts also indicate that young learners need reinforcement from parents, guardians or other people in their homes. The subsequent transcript data drawn from interviews reveals that both the home and school play a crucial role in enhancing learners' critical thinking skills through reinforcement. Lack of reinforcement has been revealed as a setback to learners' schoolwork and their development of critical thinking skills. This is corroborated by the following interview transcripts:

> Teacher 12: …*some of the things not in the child's culture…*
>
> Teacher 13*: …learners come from homes where no one would encourage them to do schoolwork…*
>
> Teacher 14*: …nobody at home asks about schoolwork…*
>
> Teacher 15: *…knowledgeable parents may give learners tasks to do…*
>
> Teacher 16*: …failing to work in loco parentis with the school personnel…*
>
> Teacher 19: *…some learners have textbooks at home to revise what they have learnt at school…*
>
> Teacher 21*: …parents may not place importance on the learner's going to school…*
>
> Teacher 23*: …parents may absent the child and certain concepts maybe covered during the child's absence…*

Based on the preceding interview transcript data, parental involvement might play a crucial role in young learners' learning and development. Empirical research has shown that the stronger the levels of parental support in a programme, the greater the benefits to the child. Experience in working with young learners has also shown that many young learners would like their parents to see them engaging in their activities. Based on the given interview transcripts presented, because reinforcement of schoolwork is not the norm in young learners' homes, it proved to be a challenge due to cultural related behaviours. On the same note, very few incidents were observed in which teachers encouraged learners during the teaching of mathematics. This lack of encouragement from

both their homes and teachers could be the reason learners did not explicitly display critical thinking skills during the teaching of mathematics. This is corroborated by the following table:

Table 5.8: Learner encouragement used to reinforce during the teaching of mathematics

Grade/level	Behaviour(s) captured
ECD A	Teacher: "*Write while speaking so that it becomes clear that you know*."
ECD B	Teacher: "*When you speak, speak lively so that I see that you are clever*."
Grade 1	Teacher: "*Read the question before raising your hands*."
Grade 3	Teacher: "*Read the problem several times before attempting the problem*."

The findings reveal that there was lack of reinforcement to enhance young learners' critical thinking skills. Teachers who encourage learners during the teaching of mathematics reinforce young learners' efforts to think critically which may be extended to improvement in mathematical literacy. The kind of reinforcement offered at ECD A and ECD B level seem to do away with the socialised behaviour traits of not talking or reluctance to speak. The kind of reinforcement rendered for Grade 1 and 2 appear as if meant to try and make young learners engage in critical thinking.

5.2.3.6 Gender as a background factor related to the teaching of critical thinking skills to young learners

Equality of opportunities for both boys and girls should be highly considered for all young learners to benefit from instruction since the challenges encountered in the changing socio-economic environment do not consider sex or gender. The excerpts from interviews indicate that every learner has the potential to think critically regardless of sex or gender. The following interview transcripts also indicate that gender equality is likely to foster the development of critical thinking skills in young learners:

> Teacher 1: …*being a boy or a girl does not matter any child can think critically…*
>
> Teacher 3*: …we cannot say these questions are for boys…*
>
> Teacher 4*: …if a child is able to think critically it does nothing to do with to do with gender…*

Teacher 5*: …all learners are the same…*

Teacher 6*: …whether a boy or a girl they have equal intelligence to think critically…*

Teacher 7: *…gender does not affect critical thinking…*

Teacher 8*: …we make boys and girls sit together or play together…*

Teacher 9*: …in modelling we make them mould the same model to avoid segregation…*

Teacher 10: *…we teach them in the same way…*

Teacher 11*: …boys and girls take up duties in groups even sweeping…*

Teacher 12*: …boys and girls also think equally the same…*

Teacher 13*: …they should learn the same subjects…*

Teacher 14: *…teaching strategies or content used should cater for diverse needs despite of gender…*

The interview transcript data reveals that most teachers do not consider gender differences in their teaching of mathematics since young learners of both sexes are given the same activities and learn the same content. Observations of mathematics lessons showed that there is no subject matter meant for either boys or girls only. There is no evidence in the presented data to show that boys are better critical thinkers than girls neither does it show that girls are better critical thinkers than boys.

The transcript data from interviews also indicate different views that teachers hold about critical thinking in young boys and girls. The results of the current research have no evidence consistent with the perceptions held about boys and girls by some of the teachers as in the excerpts that follow:

Teacher 15: *…boys getting exposed to a variety of activities…*

Teacher 16: *…restricts that boys are supposed to do this while girls are not supposed to do it…*

Teacher 17: *…learners should be rated the same …*

Teacher 18: *…hindering girls such that critical thinking skills do not develop fast in girls…*

Teacher 19*: …naturally boys and girls are different …*

Teacher 22: *…boys are better thinkers than girls…*

Teacher 23: *…in grade 1-3 girls are more intelligent than boys…*

Teacher 24: *…boys start displaying intelligence in upper grades (grade 4-7)…*

Teacher 25: *…teachers not considering gender when teaching…*

The teaching culture in the current research did not display any gender differences in terms of teaching critical thinking during mathematics teaching. Lesson observations also indicated that young learners are given the same tasks and no teacher displayed any behaviour showing differentiation in terms of gender during the teaching of mathematics or facilitation of mathematical activities.

Table 5.9: Gender sensitivity displayed during the teaching of mathematics

Grade/level	**Behaviour(s) captured**	**Cultural aspect(s) emerging**
ECD A 3-4 years	Teacher: "*We join hands even with boys to make a circle, it does not matter. Tindo get hold of that boy's hand we learn together*." Learner: Had said "*Aaah, don't touch may hand you are a boy."*	Socialised at home that girls should not play with boys.

The socialisation that boys and girls should not play together has been shown in the presented data obtained from video analysis. In social constructivism, social interaction is expected amongst learners of different sexes so that scaffolding takes place. Development of critical thinking in young children is likely to take place as young learners interact amongst themselves in carrying out mathematics tasks without considering gender.

There is a sense that globalization has become so strong that individual countries cannot circumvent its impact. Zimbabwe, like other African countries, has become part of a global village where a lot of changes are taking place. Mpofu (2013) contends that globalisation has intensified

poverty, created unemployment and promoted social integration in the majority of developing countries including Zimbabwe. The effects of globalisation include a shift from how girls used to be differentiated from their male counterpart in terms of educational opportunities. In the Zimbabwean context, boys used to be given first preference in enrolment, fees payment and other resources needed at school. The excerpts that follow indicate teachers' views concerning a paradigm shift from gender differentiation in fostering critical thinking skills in young learners:

Teacher 1: …*gender used to affect girls…*

Teacher 2: …*gender, these days is no longer affecting much…many people are equalising boys and girls*

The views given by teachers in interviews are in line with the observations made during the teaching of mathematics. The way teachers conducted their lessons, activities given and nomination of learners to give answers did not show any gender differentiation. Young learners of both sexes therefore had equal opportunities to develop critical thinking skills during mathematics teaching.

The interview transcripts indicate that, in the modern world, the focus tends to shift from where boys were given first preference in terms of going to school or fees payment to valuing the girl child. The responses from interview transcripts indicate that there is a mixed feeling on age as a factor related to the teaching of critical thinking skills to young learners. The following are the views provided by teachers in response to how age relates to the teaching of critical thinking skills to young boys and girls.

Teacher 3: *…usually young learners do not know the difference between a boy and a girl…*

Teacher 2: *…girls drop mathematics especially at secondary level…*

Based on the given views, age difference between boys and girls relates to the teaching of critical thinking skills to young learners and should be considered in the teaching of mathematics so as to foster critical thinking skills in learners of both sexes. It has been deduced from this particular research study that age difference does not affect the development of young learners' critical thinking skills until such a time when they are at secondary school.

5.2.4 Activities that may foster critical thinking skills to young learners during the teaching of mathematics

The present research study revealed strategies with which critical thinking skills may be enhanced in young learners. These include teacher activities, learner activities and methodology. Additionally, the teaching of critical thinking skills during the teaching of mathematics has been noted to enhance several outcomes, one of which is mathematical literacy.

5.2.41 Teacher activities

Various interview excerpts reveal several endeavours by teachers to foster critical thinking skills in young learners during the teaching of mathematics. The following extracts from interview transcripts reveal insights into teachers' attempts to teach critical thinking skills to young learners:

> Teacher 3: *...giving learners mentally so that they give quick answers…*
>
> Teacher 5*: ...engaging in activities that enable them to work as individuals…*
>
> Teacher 6*: ...giving learners chance to work in groups…*
>
> Teacher 7*: ...starting with questions that are not directly linked to the lesson…*
>
> Teacher 8*: ...not thinking for the learners but to establish their thoughts through asking questions…*
>
> Teacher 10: *...providing a variety of activities…*
>
> Teacher 11*: ...making learners think alone…*
>
> Teacher 12*: ...giving learners problems in their daily life for them to solve…*
>
> Teacher 13: *...keeping on encouraging them…*
>
> Teacher 15: *...giving activities that focus on different subject areas…*
>
> Teacher 16*: ...Making learners finish off stories…*

The data from interviews indicate that participants were of the view that the teacher is instrumental in learners' development of critical thinking skills. It is therefore the teacher's role to create opportunities for young learners to engage in critical thinking. As noted during observations in this

research study, teachers' activities during mathematics lessons did not place emphasis on the use of teaching resources in assisting young learners to think critically. The data shows that teachers may also assist young learners to think critically by introducing critical thinking strategies during mathematics teaching. The findings gotten through interviews converge with what obtained through video analysis where teachers were seen:

- encouraging learners to first read the problems before raising their hands
- encouraging learners to start reading the problem several times before working it out on the chalk board
- giving learners story sums such as:
  (a) There are 4 chairs in a class. How many legs do the chairs have altogether?
  (b) A class has 30 learners and each has 5 books. How many books are in the class?

Such activities by some teachers are likely to stimulate the development of critical thinking skills to young learners and may promote mathematical literacy in turn. The given story sums display the relationship between critical thinking and mathematical literacy. The presented tasks would give room for children to think critically in applying the grasped mathematical knowledge to everyday use, that is, mathematical literacy. The next sub-section looks at learner activities employed by some of the interviewed teachers to impart critical thinking skills in the young learners they teach.

5.2.4.2 Learner activities

Teacher participants in the study expressed various views concerning learners' activities in which critical thinking skills are likely be stimulated for the improvement of mathematical literacy. The following interview excerpts indicate some of their views:

> Teacher 18*: …writing story sums even at grade 1 level…*
>
> Teacher 20: *…probing the learners…*
>
> Teacher 22*: …tackling problematic situations…*
>
> Teacher 23: *…writing mental work…*
>
> Teacher 24: *…writing spellings*

Teacher 25: *…working in groups then as individuals as well as in groups…*

The transcript data from in-depth interviews do not emphasise the use of e-learning resources in teaching young learners. The observations made during the teaching of mathematics or classroom activities also revealed that teachers do not vary their teaching resources but resorted to use of resources which do not enhance much stimulation to enhance critical thinking skills during the teaching of mathematics. This is exemplified by what obtained in observing young learners engaged in mathematical activities. The media provided seem to be of the same nature across all age groups. Varied teaching and learning resources, especially technological, may stimulate the development of critical thinking skills as young learners explore different avenues in which the resources may be utilised. The behaviours exhibited after utilisation of the provided resources do not reflect much in terms of critical thinking skills displayed by young learners. From the given views, active engagement in which young learners interact with both peers and teaching resources is therefore likely to nurture critical thinking skills in young learners and, in turn, assist them in everyday application of mathematics (mathematical literacy).

5.2.4.3 Teaching methodology

It has been revealed from the teachers' responses in this study that teaching methodology can be a means to the acquisition of critical thinking skills. The following excerpts have been drawn from interview transcripts on some teaching methods teachers employ to foster critical thinking skills in young learners:

Teacher 1: …*use of different teaching methods…*

Teacher 3*: …use of discovery trips…*

Teacher 4*: …perform creative drawing own choice drawing…*

Teacher 5*: …giving full explanations during lessons or activities…*

Teacher 7*: …reciting rhymes that are in line with problems that need to be resolved…*

In-depth interview transcripts also revealed that teaching methodology influences the teaching of critical thinking skills. The views given by teachers indicate that they are different methods that may be employed in teaching mathematics for young learners to develop critical skills. Insights drawn from the responses given by teachers of young learners indicated that play may be used as

a vehicle for teaching critical thinking skills while teaching mathematics. Interpretation of the presented data indicates that teachers used varied teaching methods in a bid to develop critical thinking skills in young learners during the teaching of mathematics. Analysis of video records also indicates how some teachers varied their ways of teaching as they taught mathematics.

- Teachers motivating young learners for providing correct answers.
  (a) "*Let's clap hands for the group*."
  (b) "*Yes let's clap hands for them once*."
  (c) "*Very good clap hands for them*."
  (d) "*Yes clap hands for the triangle group*."
  (e) "*Clap hands for her*."

- Teachers giving learners opportunity to work out problems in different ways
  (a) "*Someone to come and make 2 sets of 4 using the books on the table."*
  (b) "Come and show us how much Farai got in the morning."
  (c) "Now work out these problems in your groups."
  (d) "In groups colour in similar shapes".
  (e) "Now let's look at the chart .Show me a triangle which is different from other triangles."
  (f) "Come back and show the class how you got the answer"

The way different teachers conducted their teaching created opportunities for young learners to explore ways in which to solve different problems. By extension, this may have resulted in engaging in critical thinking and promotion of mathematical literacy in the young learners.

5.2.4.4 Teaching to enhance problem-solving

Data drawn from interviews and observations indicate that it is important to teach young learners critical thinking skills since these are important in life. Transcript data from interviews reveal that teaching young learners critical thinking skills enables them to solve problems and become mentally agile. The importance of teaching critical thinking for use in later life and everyday situations is evident in the excerpts drawn from in-depth interviews with teachers of young learners:

> Teacher 8*: …without critical thinking skills learners fail to solve problems when they arise…*

> Teacher 9*: …critical thinking skills assist the child the child to solve problems…*

Teacher 10*: …learners should use critical thinking skills when they come across situations they need to be applied…*

Teacher 11*: …if learners are not taught critical thinking skills they might come across situations they may fail to think quickly on what to do…*

Teacher 12*: …critical thinking assists in life…*

Teacher 13*: …assists the child to become independent and good problem solvers…*

Teacher 14: *…if critical thinking skills are promoted whilst they are young there would be no problems…*

Teacher 15: *…starting critical thinking at university level may cause misunderstandings at workplaces or failing to solve problems…*

Teacher 16*: …learners become able to solve mathematics problems…*

The interview transcripts indicate that several teachers are of the view that critical thinking should be taught to young learners since it is necessary in problem-solving both in school and in real-life situations. Many participants indicated that it is necessary to teach critical thinking skills since they assist with real-life problem-solving. The importance of teaching critical thinking skills to enhance problem-solving in young learners has also been noted in observations made during mathematics lessons.

The next sub-sections reveal what was observed to be a result of critical thinking skills in learners during the teaching of mathematics.

5.2.4.4.1 Observations made during mathematical activities reveal the need to teach critical thinking skills for problem-solving

The following case was drawn from observations made during mathematics lessons or mathematical activities in which the need for teaching of critical thinking skills to young learners was realised as they solved mathematical problems. The following indicates how Learner 5worked out a multiplication problem to come up with the number of legs for four chairs. A theme has been drawn from the observations that critical thinking is necessary for problem-solving.

Lesson observation 6: Teacher 17

Observation made:

- *to get the number of legs for 4 chairs wrote 4+4+4+4 the learner drew 4 sets placed 4 elements in each set counted all the elements in the set and got 16*

The response given, and action taken to solve a mathematical problem by Learner 5 reveals the need to teach critical thinking skills for young learners to solve problems. The young learner is likely to have engaged in critical thinking in which he transferred the knowledge on addition and on sets to solve a problem in a different mathematical problem situation. Based on the aforementioned research study, the current research study therefore acknowledges that fostering critical thinking skills to young learners during teaching of mathematics may enable young learners to apply what they have learnt beyond the classroom context, that is, mathematical literacy.

5.2.4.5 Teaching to enhance mental agility

Empirical research has shown that it is necessary to engage young learners in brain stimulating activities during the teaching of mathematics for them to become mentally agile. The subsequent excerpts indicate that activities that foster critical thinking skills for young learners to be mentally agile since mental agility appears to be related to critical thinking:

Teacher 18: …*it improves learners in attacking questions…*

Teacher 19*: … such that when they face something they can answer without a problem…*

Teacher 20*: …a child will know how to work out certain problems in life…*

Teacher 22 *…learners develop different skills…*

Teacher24*: …becomes able to analyse…*

Teacher 25*: …teachers want to see the extent to which they think so as to start from there…*

The presented data shows that mental agility is necessary in learning as well as in their life. It is reflected in the excerpts that critical thinking is related to mental agility and should be taught to young learners thereof. The relationship between critical thinking and mental agility is also reflected in what obtained through video analysis.

(a) Teacher: "*Let's say you are given an unknown number 6* -= 12.*

*How do we get the missing numb*er?"

Learner: "*We write 12 things and put them in groups of 6*."

(b) Teacher: "*Why do you say the set is different from other sets*?"

Learner: Kept quiet gazing on the floor.

(c) Teacher: "*We have five dragon flies each has four wings. How many wings do we get*? *In other words what are we saying?"*

Learner: "*We make 5 sets and put 4 objects in each set so that we get the correct answe*r"

Teacher: "*Yes it simply means 5 sets of 4. How many wings do we get?"*

The way some teachers asked young learners gave opportunity for the development of critical thinking skills and by extension may have led to mental agility. The learners might have engaged critical thinking skills for them to come up with the answers. Through the guidance of teachers, young learners displayed their mental agility by easily following what the teachers were leading them to. For example, talking about dragon flies having four wings when they wanted to talk about sets.

5.2.4.6 Teaching to enhance lifelong learning

It can be drawn from the following interview transcripts that critical thinking skills should be taught to young learners for their lifelong learning:

> Teacher 1: …*it's the base, so learners should go for upper grades while knowing how to expand their thinking…*
> Teacher 2: …*if not taught critical thinking at an early level it will not materialise in upper grades…*
> Teacher 3: *…critical thinking helps them to think creatively…*
>
> Teacher 4*: …each subject has what to do in the life of the child…*

Teacher 5: *…critical thinking skills assist in the journey so if the child does not have the skills can get into problems…*

Teacher 6: *…so they become able to reason in the future…*

Teacher 7: *…it is the foundation of education where the child will be starting…*

Teacher 8: *…grows up with the ability to use intelligence throughout their education…*

Teacher 9: *…the child critical thinking skills in exams or after completing school…*

The transcript excerpts indicate that critical thinking is an essential asset for further education and even for the future. Based on these views, teaching critical thinking is important for lifelong learning and for use in other circumstances that are encountered in life.

The given views indicate the necessity to teach young learners critical thinking skills so that they utilise them in their lifelong learning and in real-life situations.

5.2.4.7 Teaching to enhance mathematical literacy

The data drawn from in-depth interviews reveals that it is important to teach critical thinking to young learners during mathematics lessons to enhance their mathematical literacy. This is exemplified by verbatim excerpts of the views provided by the interviewees in trying to justify the need for teaching critical thinking skills to young learners:

Teacher 10*: …important for learners to solve problems…*

Teacher 11*: …at an early age to count up to 5…*

Teacher 12: *…important in that they are applied in the day today activities of the child's life…*

Teacher 13*: …critical thinking skills are part and parcel of learner's lives…*

Teacher 14*: …should develop the skills already to apply them in situations where they are needed…*

Teacher 15*: …mathematics is used in most cases in life…*

Teacher 16: *…may use the skills to get out of family problems or the society at large…*

Teacher 17: *…assists the child in doing mathematics in future…*

Teacher 18*: …mathematical literacy helps the child to survive in the contemporary environment …*

Teacher 19*: …mathematics is something which the learners must do in their everyday life at home and at school…*

Teacher 20*: … apply learnt mathematics to solve problems they encounter…*

Teacher 21*: …when given a mathematical problem should be able to find ways of solving it…*

The presented data indicates that critical thinking fosters mathematical literacy in young learners by affording them the power in defining solutions to problems and providing a platform for reasoning. This seems to be an area for concern because some observed mathematics lessons in the current research study were dominated by a lot of chorusing of answers without fully integrating activities that might foster critical thinking skills in young learners during mathematics teaching.

The data generated from lessons observed illustrate how the teacher's questions were likely to promote critical thinking for young learners to improve their mathematical literacy. The following observations reveal that teaching critical thinking skills is necessary for mathematical literacy.

Lesson observation 14: Teacher 22

Excerpt drawn from teacher's questions:

There are 30 learners in a class each has 5 books how many books do they have altogether?

Lesson observation 15: Teacher 24

Excerpt drawn from teacher's questions:

…let's say you will be walking you are on 5and the rain starts to fall do you go ahead or back…?

The preceding data indicates that questions that foster critical thinking in young learners during the teaching of mathematics are imperative to enhance the learners' mathematical literacy. From the given views, it maybe deduced that, for young learners to be mathematically literate, they should have undergone a critical thinking process. The excerpts reveal the need to teach young learners critical thinking skills during the teaching of mathematics for learners to become mathematically literate. The problems given in the two observations are based on day to day experiences of young learners, that is, mathematical literacy.

5.2.4.8 Teaching to enhance mathematical reasoning

Teaching young learners critical thinking has been noted to enhance mathematical reasoning. The subsequent excerpts indicate that there is need for teaching critical thinking skills in learners' mathematics since this may result in mathematical reasoning.

Lesson observation 16: Teacher 2

Excerpts from learners' responses:

Learner 6: … *on 2-1 we are left with one because we have taken away 1…*

Lesson observation 17: Teacher 8

Excerpt drawn from learners' responses:

Learner 7: *…on 2 threes we got 6 because we repeated adding the twos…*

The responses indicating mathematical reasoning were provided by young learners in response to questions from teachers. From the given learners' responses, it can be deduced that there is a need to teach critical thinking skills to young learners since it is likely to aid in mathematical reasoning. Learners would, as a result, make reasoned decisions and judgments rather than regurgitating and merely returning information they come across..

5.2.4.9 Observations made during mathematical activities revealing the need to teach critical thinking skills for defining solutions to problems

Observations made during mathematical activities revealed that there is a need to teach critical thinking skills to young learners for them to find alternatives to problems they encounter either in working out mathematics problems or real-life situations.

5.2.5.10 Teaching for defining solutions to problems

The following actions were noted by the researcher during mathematics lessons as having involved critical thinking in defining solutions to challenges meet by young learners in working out mathematical problems.

Lesson observation 18: Teacher 10

Excerpt drawn from learners' actions:

> Learner 9: …*hid the fourth bottle top when the teacher was checking whether the learners have managed to count the bottle tops*

Lesson observation 18: Teacher 13

Excerpt drawn from learners' actions:

> Learner 10*: ... peeping to copy a neighbour on the opposite side when the problem got tough for him*

The observations made revealed that there is a need to teach young learners critical thinking skills because these assist learners during the teaching of mathematics and help to transfer what they have learnt to solve problems they encounter. The excerpts show that critical thinking skills existence or availability of critical thinking skills in young learners determines how they define solutions to their problems.

5.2.4.11 Teaching to enhance the understanding of concepts

Critical thinking is said to enhance learners' understanding of mathematical concepts. The teachers are of the view that it is necessary to teach young learners critical thinking skills since this has to do with understanding of concepts. This is corroborated by the themes drawn from interview transcripts revealing that teaching critical thinking skills enhance learners' understanding of concepts:

> Teacher 15: ...*learners without critical thinking do not tackle concepts…*
>
> Teacher 16*: ...there are some concepts which need thinking…*
>
> Teacher 17*: ...help learners to quickly grasp concepts when learning mathematics…*

Teacher 18*: …mathematics is the main subject which should be known by learners and how mathematics go about…*

Teacher 19*: …where a child understands mathematics involved in day to day use…*

In trying to define mathematical literacy, participants also brought in the issue of understanding of concepts and transfer of knowledge in day to day use. This is exemplified by the following excerpts from the interview transcripts:

Teacher 2: …*someone can understand even very old person at home has mathematics*…

Teacher 4: …*where the child or someone understands mathematics and is involved in mathematics on day to day basis…*

Teacher 5: …*one is supposed to understand how to make use of mathematics in life*…

Teacher 9: …*it does not necessarily mean that we should be at school it's something around us…*

It has been deduced from the presented interview transcripts that young learners are likely to acquire mathematical literacy in the process of thinking critically during mathematics lessons or activities. The themes from both interviews and observations were drawn to exhibit the importance of teaching for critical thinking skills to young learners during mathematics lessons or activities to foster mathematical literacy. Understanding of concepts is thus likely to enhance the ability to use the skills in real-life situations.

5.2.4.12 Teaching to distinguish shapes and concepts

The observations made during mathematics lessons or activities noted young learners managing to make a distinction of the different shapes that were provided. This is exemplified by the excerpts that follow:

Lesson observation 19: Teacher 15

Excerpts from learners' responses:

Learner 10*: … a triangle is like a roof of a hut…*

Learner 11*: … it's like a grass thatched hut…*

Learner 12*: ... it's like a shed…*

Learner 13: *... a circle is like a ball…*

Learner 14*: …a square is like a box…*

The preceding excerpts reveal that young learners can think critically to establish mathematical understanding by associating what they are learning to what they already know (mathematical literacy).Through observing mathematics lessons and activities, the researcher noted that young learners used their critical thinking skills, imagination and managed to distinguish the shapes by providing similar structures in real-life situations. The presented data indicates that there is a need to teach critical thinking skills during the teaching of mathematics to enable young learners to associate what they learn to the real world (mathematical literacy).

5.2.5Learner action made during mathematics teaching revealing the need to teach critical thinking skills for independent thinking

The need to teach young learners critical thinking to foster their independent thinking is indicated in the subsequent examples that were drawn from learners' actions during mathematics lessons.

Lesson observation 20: Teacher 17

Observations made:

Learner 16*: …decided to join distribution of books when actually not a group leader…*

Learner 17*: ... used wooden blocks as clappers…*

Learner 18*: ... recites a mathematical rhyme without the teacher's instruction…*

Learner 20: *... claps hands for a colleague who got an answer correct…*

Data from both in-depth interviews and observations of lessons have shown the need to teach young learners critical thinking skills for them to become independent thinkers. Based on what has been solicited from interviews and observations of mathematics lessons and activities, it is imperative to teach young learners critical thinking skills. Indicators for enhancing independent thinking have been shown in the given excerpts. Deducing from the given observation independent thinking may as well result in improvement in learners' mathematical literacy.

5.3 Conclusion

In this chapter, data from interviews were presented as excerpts under different themes drawn from interpreting and identifying similarities in the responses given by different teachers. Data from observations and video analysis were tabulated. The findings on factors influencing the teaching of critical thinking skills, how critical thinking skills are taught and why there is a need to teach critical thinking skills during the teaching of mathematics have been presented and analysed. The subsequent chapter discusses findings of the present research study. The findings of this research study have been substantiated with literature in the context of the study research questions.

CHAPTER 6: DISCUSSION OF FINDINGS

6.1 Introduction

The research study explored the teaching of critical thinking skills to improve mathematical literacy in learners in the 3-8-year age group. The focus of this section is on the discussion of the findings of the research study in light of the three research questions presented in the introductory chapter. The major headings which have been derived from the research questions include: What factors are related to the teaching of critical thinking skills? How are critical thinking skills taught to young learners? Why is there a need to teach critical thinking skills to young learners?

6.2 What are the factors related to the teaching of critical thinking skills?

The current section discusses findings from the research study on factors related to the teaching of critical thinking skills to young learners in the 3-8-year age range. The research study reveals that there are different factors that are related to the teaching of critical thinking skills to young learners in an endeavour to foster or improve their mathematical literacy.

6.2.1Age as a factor related to the teaching of critical thinking skills to young learners

Based on the views drawn from interviews, chronological age has been found to be related to the teaching of critical thinking skills to young learners since the data from interviews indicates that critical thinking develops as learners grow. The transcript data from interviews indicate that most teachers believe critical thinking develops as a learner grows chronologically to explore the environment more widely. The finding of the study indicates that as learners grow older behaviour traits that stifle the development of critical thinking skills shade off to create opportunity for improved critical thinking skills. A research study conducted by Stocks, April, and Lynton (2012) in South Africa tested the hypothesis that the critical thinking dispositions of first grade learners would be significantly lower than those of the fourth-grade learners. The results from Stocks and his co-researchers indicated that the arithmetic means of critical thinking dispositions of senior learners were significantly higher when compared to first grade learners. The study is in line with the finding of the present study that 8-year olds exhibited more critical thinking characteristics than the 3-4-year olds. Chronological age is therefore likely to influence the learner's critical level of thinking.

Visande (2014) acknowledges that once young learners are used to the habit of thinking, they develop to higher levels of thinking until they reach the formal operational stage, the highest form of thinking a human being can reach. Amineh and Davatgiri (2015), in a research study conducted in Iran, added that young learners develop their thinking abilities through interaction with peers, adults and the physical world. Based on the social constructivist epistemology which guides the present study, critical thinking skills of young learners during mathematics lessons or mathematical activities were likely to be developed through interacting with their peers in groups which ranged from two to thirteen similarly young learners.

Since age has been noted to influence the teaching of critical thinking skills to young learners, it is imperative for teachers of young learners to consider their age when teaching critical thinking skills so as to improve mathematical literacy of young learners. When learners are young, they should be equipped with age appropriate skills such that the level of skills required increase as they grow and develop. This research study confirmed that as learners progressed through the grade levels their critical thinking characteristics improved. This is consistent with Piaget's (1977) theory in which young learners pass through several stages of development experienced at varying operational levels. In line with the results of this research study, is a finding by Dunn, Rakes and Rakes (2014) which confirms that age was a significant predictor for critical thinking skills and that, as the age of learners increased, their critical thinking levels also increased. It can be concluded that, as relates to imparting critical thinking skills to young learners, age should be consciously considered during the teaching of mathematics for learners to develop their skills and improve their mathematical literacy.

The development of the learners' critical thinking skills is compromised in restrictive thinking environments where there is failure to provide proper assistance in fostering such skills (Nilson, Fetherstone & McMurray, 2013). The results of the current research study reveal that young learners are capable of thinking critically and that critical thinking skills and abilities can be taught across all age levels under study as long as the culture of young learners is not restrictive. Young learners are therefore likely to be assisted to think critically in developmentally appropriate learning environments if provision of instruction considers their age levels

The finding of the current research study also indicates mental age, just like chronological age, has an effect on how learners think, especially when the cultural background interferes with teaching and learning of young learners All content or activities provided for young learners should therefore consider their contexts in teaching critical thinking skills to promote mathematical literacy. Vygotsky (1978) stresses the importance of learners' social interaction with knowledgeable members of society. Based on Vygotsky's standpoint, the acquisition of critical thinking skills and how to utilise them (mathematical literacy) are dependent on social interaction with more knowledgeable people. Social interaction as a tenet of social constructivism may be considered in having groups of young learners at different mental levels working together in solving mathematical problems so that those at a lower mental level may be assisted by those who are at a higher mental level. This is likely to improve the situation in the observed lessons in Zaka schools where young learners were not adequately supported by their teachers to develop critical thinking skills. The learners were not assisting one another in group activities since whispering or talking in low voices are not characteristics of young critical thinkers. The researcher's sentiments are corroborated by Tunca (2015) who emphasises the importance of creating a supportive and collaborative environment by teachers to foster the development and application of critical thinking skills in young learners.

6.2.2Culture as a factor related to the teaching of critical thinking skills to young learners

This research study reveals culture as a major factor related to teaching critical thinking skills to young learners during the teaching of mathematics. The research study further indicates that learners' critical thinking skills are affected by their home background which is also embedded in young learners' culture. In line with the findings of this research study is a critical analysis of Zimbabwean culture by Rutoro (2013) who acknowledges that cultural values are so deeply ingrained such that it is not easy to change the ingrained beliefs in learners. Guo (2013) argues that culture is important because it tells us in different degrees what we are expected to think, say, and behave in typical life situations. The participants in the present research study pointed out several culturally related factors that influence the teaching of critical thinking skills to young learners during the teaching of mathematics.

The present research study further reveals that learners' critical thinking skills may be affected by their home background which may fail to reinforce the young learners' schoolwork or fail to

provide adequate stationery. This is consistent with Bronfenbrener's (1979) ecological systems theory in which a learner grows up in a system of social networks which influence his/her development in one way or another. Along similar lines, Bali (2015) observed that the notion of the individual is different in Islamic cultures and this, given that individual voice and stance is a key component of critical thinking, affects ways in which learners express themselves and their ideas. Similarly, the failure by young learners in the current study to explicitly display critical thinking skills during the teaching of mathematics is attributed to culturally restrictions on speaking and talking imposed on young children. Sohel (2012) acknowledges that social constructivists value both the context in which learning occurs and the social contexts that young learners bring to their environment. Inversely, people in the young learners' social context are likely to affect how they think and the degree to which they think critically and the improvement in their mathematical literacy.

The preceding data indicates that young learners are greatly influenced by adults such that they are left with no option except to follow the expectations of their elders. The finding of the present research study reveals that young learners have no freedom to decide or give opinions but conform to what adults say which may compromise their development of critical thinking skills. This finding corroborates what Guo (2013) maintains about the Chinese collectivistic culture, that harmony and cooperation among the group tend to be emphasised more than the achievement by individuals. It is therefore likely that the upbringing of a learner, especially where he/she has to conform to what adults expect, may stifle the development of critical thinking skills. This was evident in the schools which were under study as learners were in some instances asked to be silent while in another moment were asked to speak. Compliance with norms may thus inhibit individual beliefs which are needed in critical thinking skills. It can therefore be argued that the influence of culture on critical thinking skills of young learners may negatively affect the teaching of critical thinking skills during mathematics teaching so as to boost their mathematical literacy.

Additionally, the present research study reveals that learners' thinking is influenced by the community in which they live. The community is part of the young learners' culture. In the Zimbabwean context, especially among the Shona speaking people in which the present research study was undertaken, the thinking of learners was influenced by what was expected in their community. Learning experiences are derived from community activities since they are based on

day to day experiences of the learner (mathematical literacy). The finding shows that how learners acted during mathematics lessons was to meet the expectations of their society because some of the behaviours might not be allowed in their culture. The study reveals that cultural traits in the community, such as not talking in the presence of adults, conformity to what adults say and not asking questions, are some of the setbacks to the development of critical thinking skills among young learners. In a research study conducted by Rutoro (2013), it was noted that culture in Zimbabwe is not by biological inheritance but a product of a social group which is passed from one generation to the next by learning and through sharing perceptions and attitudes. Similarly, McKinley (2013) is of the view that young learners who are raised under social practices where group harmony and conformity are stressed, may be perceived to be deficient in critical thinking skills compared to learners from other cultures who work as separate entities. Based on the findings of the current research study, young learners' cultural context is thus attributed to having a great impact on young learners' development of critical thinking skills in a variety of ways. This may become a barrier to the teaching of critical thinking skills to enhance learners' mathematical literacy. In the current research, culture is therefore accredited to negatively affect the teaching of critical thinking skills to young learners and, by extension, leading to failure to apply mathematics to day to day living (mathematical literacy).

A Canadian research study conducted by Grusec and Danyliuk (2014) revealed that one determinant of learners' behaviour lies in their general attitudes as well as specific beliefs that are activated during parenting. In the current study, it was observed that young learners were socialised not to speak in the presence of adults or many people resulting in reluctance to speak even when asked to or whispering during the teaching of mathematics. This is likely to stifle the critical thinking skills of learners. As the present research study reveals, young learners were rarely given the opportunity to exercise their thinking during the teaching of mathematics. Similarly, Guo (2013) believes that the degree to which a culture is individualistic or collectivistic has an important impact on learners' thinking processes.

In line with the finding of the present research study, Gorman (2017) found out that in California young learners who reason with adults are strong willed and are more willing to do what is right rather than what their friends are doing. The aforementioned Californian study also noted that learners who are not always influenced by those around them express what they think and usually

win over those in the negotiation. The finding of the present research study indicates that some expectations of the community may stifle young learners' critical thinking skills. Young learners who were observed during the teaching of mathematics were not asking the teachers questions right across all the age level under study. This likened to their culture which expects young learners to religiously following what adults say since they are not expected to question what the community expects of them. Health (2012) admits that people from different cultures might find clues they could use in their own processes of critical thinking. The present study concludes the teaching of critical thinking skills to young learners may be heavily influenced by the contexts in which they are raised and how they were socialised resulting in failing to make sense of the acquired mathematical knowledge (mathematical literacy).The next section focuses on learners' backgrounds and their influence on the teaching of critical thinking skills to young learners.

6.2.3 Background as a factor that has an influence when teaching young learners critical thinking skills

The present research study reveals that young learners' backgrounds may influence the development of critical thinking skills during the teaching of mathematics. This research study indicates that, across all age groups observed, no technological tools were used during the teaching of mathematics to young learners. Failure to provide technological tools during the teaching of mathematics is likened to the background of families and schools under study. These are in rural areas where technology might not have been fully established. The researcher assumes that, if teachers had included technological tools in their teaching, young learners could have explored the tools and by extension engaged in critical thinking. Failure to explicitly exhibit critical thinking during the teaching of mathematics is therefore accredited to the complete absence of technological tools during the teaching of mathematics to young learners. Engaging in critical thinking with technological tools is likely to improve young learners' application of basic mathematics in everyday life (mathematical literacy).

The finding of this research study converges with a study conducted in San Francisco in which Taylor (2012) indicated that exposing young learners to video games and other screen media allows them to engage in higher order processing such as contemplation, critical thinking and problem-solving. The research study also concurs with an international study conducted in Europe in which Chaudro (2015) suggested that young learners' digital activities engender creativity,

imagination, social skills knowledge acquisition, eye-hand coordination and educational provision for the future. Experience in the contemporary world has shown that information and communication technology (ICT) is significantly enhancing and altering human activities, enabling people to live, work and think in ways that most of us never thought possible.

In a research study conducted in Minnesota, Hitler (2015) indicated the need for young learners to have critical thinking skills for them to become successful in their future. Additionally, Turnipseed (2013) carried out a research study in the USA which showed that, if young learners are to become critical thinkers and problem solvers, they should continue to be equipped with science, technology, engineering and mathematics (STEM) skills. It is therefore necessary to use technological resources in the teaching of mathematics to develop learners' critical thinking skills, problem-solving abilities as well as to improve their mathematical literacy. The social constructivist perspective focuses on the teaching that fosters critical thinking skills as learners engage in social learning activities that involve hands-on activities and utilisation of discipline - based cognitive tools (Bazluki, Chamberlain, Martin & Mitchell, 2012). Together as a group young, learners may thus make use of their thinking to come up with a product. Based on the social constructivist view, young learner in the current study could have interacted with their peers while sharing ideas in groups assisting one another, making decisions, asking questions while interacting with teaching and learning resources for them to develop critical thinking skills. This is beneficial more than the traditional memorisation and chanting of answers in chorus that was observed during the teaching of mathematics during the present research study.

Guo (2013) argues that one important step in helping young learners to develop critical thinking is having an understanding of the target culture itself. Some participants in this study indicate that some learners come from backgrounds bereft of technology while others are from homes where technology has already been established. The finding of the present research study indicates that technology is a factor that has an impact on the development of critical thinking skills in young learners because one of the interviewees indicates that some of the learners come from homes bereft of any ICT gadgets (may be parents or guardians cannot afford to buy due to poverty). The finding also reveals the importance of electronic teaching resource in enhancing critical thinking skills in young learners. One of the interviewees stated that some learners are used to operating technological resources when doing mathematics. This is contrary to the finding of the present

research study because no technological resources were used as teaching resources during all mathematics lessons that were observed. Despite teaching in the era of technological advancement, where electronic gadgets should be at the fore in fostering critical thinking skills to the young generation, only work cards, shapes and counters were commonly used by teachers as learning resource in most of the mathematics lessons observed during the present research study. The use of technological resources could foster the young learners' critical thinking skills in order to improve mathematical literacy. Critical thinking skills are key components in preparing young learners to live in an era of science and technology (Vieira, 2014).

Failure to explicitly display critical thinking skills by young learners during the teaching of mathematics could be attributed to their poor school and home backgrounds which inhibit the development of critical thinking skills. Such poor school and home backgrounds, illustrated by complete absence of technological tools in the teaching of mathematics, may be attributed to failure to develop critical thinking skills and improvement in mathematical literacy in young learners in the study. The finding of this research study shows that the resources provided by teachers in the mathematical activities of young learners determined how teachers assisted the young learners in the teaching process.

The finding of the present research study is, furthermore, in line with Visande (2014) who articulates that interpretation is one of the critical thinking skills in which learners display the ability to understand and convey sense or make use of in a wide variety of situations. Piaget (1977) notes that, when interacting with materials, young learners become active meaning makers where imbalance is created. When an imbalance is created young learners are forced to engage in critical thinking and by extension relate the concepts learnt to everyday use (mathematical literacy).Thus, on the basis of Piaget's standpoint, young learners make sense of new information by restructuring their present knowledge to a higher level of thinking and this may only be possible when they use critical thinking skills while interacting with learning resources. The availability of resources, including those technological, may therefore positively influence how teachers teach or facilitate the learning process during mathematics teaching for young learners to acquire critical thinking skills.

It may be concluded that a lack of resources in learners' homes and schools is attributed to stifling the young learners' acquisition of critical thinking skills during the teaching of mathematics right across all the age levels under study. The finding concurs with international research study conducted in the United Kingdom in which Shakuntala (2013) proposes that a lack of innovative and creative resources may inhibit learners' creativity, knowledge and critical thinking skills. Similarly, social constructivists believe that direct physical interaction with resources is often effective in enhancing learners' critical thinking (Beilock, 2017). Shim and Li (2012) view cognitive tools as any resources that can support aspects of learners' cognitive processes that may allow young learners to make use of their critical thinking skills in problem-solving (mathematical literacy).In a survey of early childhood educators in the four states of Australia, Hunting, Mousley and Perry (2012)found out that there was an agreement by teachers that, if young learners are provided with material resources, they are capable of mathematical activity and thought well before they started school. Learners' background experiences in their families and their parents' socio-economic status may therefore influence their learning and their development of critical thinking skills. The current research study observed some parents who could not afford to provide adequate stationery for learners to be fully engaged in their learning of mathematics for critical thinking skills to develop and improve in mathematical literacy. According to Perry and MacDonald (2015), resources provided to young learners by the family home environments strongly predict educational and behavioural outcomes for young learners well into the primary years. This is in line with the views provided by teachers during in-depth interviews indicating that availability of resources depends on learners' background since some of them may come to school without books or pencils or even on an empty stomach. It was also noted through observation that some young learners failed to write their daily mathematics exercises because did not have exercise books. Young learners who find themselves seated while peers are writing may develop a low self-esteem and, by extension, stifle the development of their critical thinking skills.

The findings of this particular research study further indicate that teachers have mixed views on the effects of intellectual support from young learners' backgrounds on their acquisition of critical thinking skills. The finding reveals that learners' critical thinking skills can be inhibited by lack of support from adults as well as their poor socio-economic status. One of the responses from participants in this study indicates that young learners can think critically despite coming from families of poor economic status quo. Consistent with this finding, Jones (2015) maintains that

one critical way to support the positive development of all young learners is involving their families. The Centre for the Study of Social Policy (2012) proposes that variables such as poverty, trauma and inadequate treatment of young learners have a profound impact on their mental well-being and further asserts that stable secure and nurturing relationships are a core component of young learners' development of critical thinking skills. Offering intellectual support thus becomes a factor which may promote the development of critical thinking skills in young learners while lack of support may stifle their critical thinking skills. Observation of teachers during mathematics teaching indicates that some teachers were making efforts to emotionally support learners by encouraging them to participate during mathematics lessons. This might have assisted learners to be stable thereby creating an opportunity to engage in critical thinking. Some teachers in this study were also observed displaying their authority over young learners and this could have stifled the development of critical thinking skills during the teaching and learning of mathematics. Perry and Mac Donald (2015) argue that learning outcomes are most likely to be achieved when early childhood educators work in partnership with families to create a welcoming environment where young learners are mentally relaxed to engage in high order thinking activities.

The finding of the present research study also reveals that without emotional support, learners experience a setback in the development of critical thinking skills. Thapa, Cohen, Higgins-D'Alessandro and Guffey (2012) believe that the school climate is associated with a range of positive learner outcomes, from academic achievement to mental health and well-being. Limited support by families and teachers in the current study is attributed to why young learners were not exhibiting critical thinking skills during the teaching of mathematics. The finding of this research study further indicates that lack of emotional support by parents may lead to low self-esteem in learners and low self-esteem is not a characteristic of critical thinking skills. Ennis (2011) believes that critical thinking skills involve asking questions and giving alterative answers. The current research study notes that, contrary to the promotion of the development of critical thinking skills, young learners with low self-esteem are on the lower ladder of critical thinking because they hardly exhibit any characteristics that have to do with the "habit of the mind" (Aizikovitsh-Udi & Cheng, 2015, p.456). Offering emotional support to young learners by families is therefore related to the teaching of critical thinking skills in that, if young learners are supported and motivated by their families, their critical thinking skills are likely to be enhanced due to high self-esteem. Research notes that a strong social and emotional foundation in early childhood strongly influences learners'

latter positive attitudes and behaviours, academic performance, critical thinking skills and even their career path (Visande, 2014; Jones, 2015).

Through observations of mathematics lessons in the current research study, it was shown that teachers usually offer emotional support to young learners in the manner they speak to them. In the present study some teachers were observed cordially encouraging learners to speak loudly while others were harsh to them. It was shown that, under harsh conditions, young learners became frightened and limited chances of thinking critically were created. The finding of the current research study is consistent with a research study at Johns Hopkins Bloomberg School of Public Health in Blum (2015) which discloses that no factor is more important for positive school outcomes than learners' perception of the teachers' attitude towards them. The current research study, therefore, posits that teachers have an obligation to develop a positive environment in which they value and welcome mutual respect and mistakes made by learners during the teaching of mathematics so as to increase chances of enhancing critical thinking skills in young learners. In a research study conducted in Alexandria, Jensen (2013) argues that young learners with unstable home lives are particularly in need of strong, positive and caring teachers for them to be free to explore and think critically. This demonstrates that young learners need positive relationships with their teachers for them to develop their critical thinking skills in order to make sense of mathematics (Hintz, 2014).

The present research study displayed that there was limited reinforcement of schoolwork in form of encouragement towards the development of critical thinking skills from both the teacher and home. Reinforcement, either by the teacher or parents, is accredited to why learners were not displaying critical thinking skills during the teaching of mathematics. This finding is consistent with a view given by Mawere, Thomas and Nyaruwata (2013) that parents and teachers should collaborate to ensure that young learners receive appropriate care, skills and that development is enhanced. In order for young learners to think critically, there should therefore be reinforcement in terms of provision of resources and encouragement by both teachers and parents. Based on theories of child development, understanding the stages of child development helps parents and teachers know what to expect and how best to support learners as they grow and develop. The Center for the Study of Social Policy (2014) believes that the promotion of early childhood social

and emotional development is the first step in prevention and early intervention in addressing young learners' needs.

The findings of the present research study indicate that young learners who lack reinforcement from their parents or guardians at home do not display critical thinking skills. It is quite clear that families are important contexts for young learners and that they do have a significant impact on the learning opportunities provided to them (Perry & MacDonald, 2015). Lack of reinforcement on schoolwork has been revealed as a setback to learners' development of critical thinking skills. In their Australian research study, Butterworth, Olesen and Leach (2012) noted that one reason many learners seem unmotivated is lack of reinforcement from their parents or guardians. Additionally, Makuni and Francis (2012) argue that teachers expect parents to pay school fees, provide teaching resources and to interact with teachers regularly. The reinforcement of school work at home and in collaboration with teachers is therefore likely to motivate young learners to explore and boost their chances to think critically and improve on mathematical literacy.

6.2.4 Gender as a factor related to the teaching of critical thinking skills to young learners

The present research study established that teachers did not consider gender during the teaching of mathematics. Both sexes were therefore learning the same content and providing young learners with the same activities or group tasks. Equality of opportunities for both boys and girls appear to be seriously observed right across all age groups under study. All young learners need to benefit from instruction since challenges encountered in the changing socio-economic environment do not consider sex or gender. In a doctoral research study in Zimbabwe, Rutoro (2013)found out that there are some gendered misconceptions in the Shona culture that men are fast thinkers, problem-solvers and rational while women are slow thinkers, poor at solving problems and irrational. Contrary to these misconceptions or illusions, the finding from observations of mathematics lessons and activities in this study also reveal that there was no subject matter meant for either boys or girls only. This misconception is also noted in another Zimbabwean research study by Rutoro, Jenjekwa, Runyowa and Chipato (2013) who mention that women in general are regarded as emotionally weak and their thinking is usually controlled by emotions, and such qualities are not characteristics of critical thinking. Rutoro (2013) also found out that some gendered misconceptions about boys and girls could stifle critical thinking skills in girls while it may nurture

the same in boys since young learners may live to what is expected of them by society in which they live.

Teachers' responses to open-ended questions on how gender relates to the teaching of critical thinking skills indicated that boys and girls are socialised differently, and others believe that they have different preferences. In their research study, Rutoro, Jenjekwa, Runyowa and Chipato (2013) take a critical look at the Shona culture ways of thinking. The study revealed that many misconceptions are regarded as true in the Shona culture in which this current research study was also conducted. This may affect perceptions of people on the discrepancy between boys and girls ability in school. Consistent with perceptions held about boys and girls, responses from interviewees in the present research study reveal that gender differences are likely to affect learners' critical thinking skills negatively or positively depending on how society regards the boy or girl child. OECD Report (2012) reports that gender equality in educational participation and attainment has been achieved in most OECD countries. Lesson observations also reveal that young learners in schools where the study was conducted were given the same tasks and no teacher displayed any differential behaviour in terms of gender during the teaching of mathematics. This created equal opportunities for the development of critical thinking skills by both boys and girls. From the evidence provided, it may be inferred that gender differences may influence the teaching of critical thinking skills to young learners where equal opportunities are not considered during mathematics lessons or activities.

Zimbabwe, like other African countries, has become part of a global village where a lot of changes are taking place. The changes include a shift from how the girl child used to be differentiated from her male counterpart in terms of educational opportunities. A research study conducted by Sue (2014) at Crenefield College in the UK concluded that girls perform better than boys in schooling in most countries, a fact that seems to be a well-kept secret considering how little attention it has received as a global phenomenon. The same research study revealed that few explanations are given for boys' performance which may be due to social factors like parents placing less emphasis on boys' studies because their performance may be assumed to be better. This particular research study responses from interviewees have shown that in the studied Zaka schools, the boy used to be given first preference in fees payment and provision of other resources needed at school and even got enrolled first in school. The finding of this research study is in line with what was noted

by Rutoro (2013) that different expectations concerning roles for men and women have had an impact on the enjoyment of rights, equal access to opportunities and to participation in decision-making at all levels.

Additionally, Ouma (2016) in the international literature notes that the African traditional society from the fifties to seventies preferred to educate the boy rather than the girl. For example, programmes such as *Bolsa Familia* in Brazil and *Juntos*in Peru include cash transfers paid to mothers on the condition of their daughters' continued school attendance. *Oportunidades* in Mexico provides more cash for daughters than sons in order to increase incentives for girls to attend school. In support of attainment of millennium development goals (MDGs), OECD (2012) adopted a mix of policies to facilitate girls' completion of a quality post-primary education in developing countries by identifying existing good practices that could be replicated. Contrary to the given world views, UNICEF (2012) reported that, in many countries around the world, girls traditionally have been at a disadvantage. However, in a mid-decade review of education for all (EFA), it was indicated that boys' enrolment rates have declined and, in some settings, enrolment, attendance and achievement are decreasing for boys. Onsaringo (2013) argues that schools are more sensitive to girls' needs than those for boys. Generally, the paradigm shift from placing importance on the education of the girls is critical but it is also important to guard against depriving the boy to think critically by giving the girl more privileges at the expense of the boy.

Basing on cognitive theory (Piaget, 1977), it can be noted that learners of different ages can perform differently considering that they might be on different stages of development. Visande (2014) notes that Piaget's clinical and observational studies developed an idea of readiness and explored the process by which learners advance through the sensor motor stage (0-2 years) and pre-conceptual stages (2-7 years) in order to progress to logical and abstract thinking. From Piaget's standpoint, it may be proposed that the age difference between the girl and boy influences the teaching of critical thinking skills in that the critical level at which young learners operate at is determined by their age as well as their gender socialisation. In addition, Dunn Rakes and Rakes (2014) assert that age was a significant predictor for critical thinking dispositions and, as the age of participants increased, their critical thinking levels also increased. The teaching of critical thinking skills to young learners should therefore consider gender during the teaching of mathematics so as to foster critical thinking skills in learners of both sexes. It has been deduced

from this particular research study that age difference does not affect the development of young learners' critical thinking skills until such a time when they are at secondary school.

6.3 How are critical thinking skills taught to young learners?

Responses from interviewees indicated that there are many ways in which teachers can enhance critical thinking skills in young learners during the teaching of mathematics. Participating teachers proposed giving learners mental work and giving learners a chance to work in groups so as to scaffold one another. Even though learners were working in groups of 2-13 members, it proved to be of very little benefit since they were whispering to one another. It is questionable whether learners strike any chances of developing critical thinking skills while speaking in low voices. Choy and Oo (2012) speculate that learners may not be able to think critically because their teachers are not able to integrate critical thinking sufficiently into their daily practice as it requires a certain amount of reflection.

6.3.1 Teacher and learner activities

The study revealed that, right across the age levels under study, there was a lack of provision of learning resources to stimulate the development of critical thinking skills in young learners. In an American research study, Crockett (2015) established that the role teachers' play in developing critical thinking is different from the role they are typically playing. In line with the aforementioned research study, Henderson-Hurley and Hurley (2013) view the teacher's role as that of a facilitator who should encourage activities that enhance critical thinking skills even in very young learners. Based on the finding of the research study, the teacher could be a key player in fostering critical thinking skills during the teaching of mathematics to improve mathematical literacy in young learners. The finding of this research study is in line with another study carried out in the USA by Hudson (2017).The study indicated that preschool teachers in the USA play an important role in building a learners' success in their first years of school by using a variety of methods to help them grow cognitively as well as intellectually. Ancill (2014) submits that critical thinking is an elusive concept though it appears as if there are two broad concept camps; first, arguing that it is a set of skills that can be taught or learned and secondly, that it is a disposition that cannot be taught but can perhaps be encouraged and nurtured. The participants in the present study also claimed to use a variety of activities that stimulate the development of critical thinking

skills. However, through analysis of video records very little was done by teachers to stimulate critical thinking skills in young learners. Some of the teachers used story sums to stimulate young learners' critical thinking skills and improved mathematical literacy in the learners since the story sums were based on day to day experiences.

The finding of the present research study is also in line with a study conducted in Thailand by Thaiposri and Wannapiroon (2015).The two established that teachers in Thailand spark learners' interests and curiosity by using short activities or examples that link to prior knowledge in which they may analyse interpret and draw conclusions. In line with the aforementioned research study, Zane (2013) agrees that accustoming young learners to think critically needs a conscious and planned effort where the teacher integrates appropriate models in the teaching process for the improvement of critical thinking. Similarly, Amineh and Davatgiri (2015) assert that social constructivism stresses the importance of learners' social interaction with knowledgeable others with the assistance of the teacher. In the constructivist approach, in teaching critical thinking skills to young learners teachers are more of facilitators and regard every learner as an integral part of the teaching process.

Additionally, it was noted during lesson observations in this particular research study that activities employed by teachers during mathematics lessons did not make use of stimulating teaching resources in assisting young learners to think critically so as to improve their mathematical literacy. The resources teachers provided were of the same nature right across the age levels in question. Counters, shapes in different colours, work cards, number lines were common resources used right across all the age levels under study. In a research study conducted in Chicago, Beilock (2015) revealed that reading about a concept in a textbook or seeing a demonstration in class is not the same as physically experiencing what learners would be learning about. This revelation is in line with Ramezeni (2016) who believes that teachers' recognition of potential critical thinkers may change the teaching process to enhance critical thinking skills in young learners which in turn may lead to improvement in mathematical literacy. It was noted during observations in the present research study that activities teachers engaged in during mathematics lessons did not place emphasis on the use of teaching resources which could have stimulated young learners to think critically.

Learners ought to be provided with resources to use during the teaching of mathematics since, according to social constructivists, young learners learn better through interaction with other people or resources. This concurs with a research study carried out at Cornell University by Kushnir (2012) in which one of the recommendations was that teachers should provide stimulating environments which involve different outcomes for young learners. Drawing from the social constructivist perspective, interaction with teaching resources may develop learners' critical thinking skills as they explore the processes which in turn may lead to mathematical literacy and problem-solving. In another American research study, Galinsky (2017) recommends that young learners should be provided with opportunities to play and testing how things work to develop critical thinking, and further emphasises that these hands-on experiences provide an integral foundation for latter abstract thinking. Similarly, Dewey (1933) views learning as creating a meaning for an experience whereby the learner moves to a deeper understanding of relationships and connections between that experience and other experiences and ideas.

The mathematics lesson observations revealed that teachers did not vary their teaching resources but resorted to use of work cards in the teaching of mathematics to young learners. Failure to provide stimulating materials is contrary to Rotumoi and Too (2012) who argue that the opportunity to interact with materials, peers and teachers helps young learners to develop self-esteem and critical thinking skills. Based on the social constructivist epistemology, young learners learn through social interaction and, as they assist one another, they are likely to engage critical thinking skills. A Malaysian research study by Kamarulzaman (2015) established that young learners learn most important concepts by constructing knowledge themselves while interacting with the physical world and with other learners through play. This may mean that critical thinking skills in young learners may be enhanced if teachers provide concrete media and let learners explore during the teaching of mathematics to stimulate their critical thinking skills which, in turn, may lead to improvement in mathematical literacy.

Social constructivists believe mathematical learning involves active manipulation of meaning and understanding, not just numbers and formulas (Barret & Long, 2012).On the same note, Oguntoyinbo (2012) admits that good mathematics instruction promotes critical thinking through active learning experiences and communication through meaningful interactions with real-world problems. Active engagement, in which learners interact with both peers and teaching resources,

could foster critical thinking skills in young learners and, in turn, assist them in everyday application of mathematics (mathematical literacy).

6.3.2 Teaching methodologies

The present research study indicates that teachers for young learners make use of different methodologies that may foster critical thinking skills in learners during mathematics teaching. Rotumoi and Too (2012) concedes that it is necessary to implement teaching methods that involve activities based on senses and that instructional resources are influenced by the choice of teaching methods used in early childhood development(ECD). The method of teaching critical thinking skills requires young learners to engage in independent thinking such as problem-solving, analysing and evaluating information (Shen, 2012).It has been learnt from the responses given that methodology may become a means to the acquisition of critical thinking skills. However, not much was noted in terms of methodology in teaching either in lesson observations or during face to face interactions with teachers during the teaching of mathematics. Responses from interviewees claim the use of different teaching methodologies, use of discovery trips and giving full emphasis during lessons or activities. Observations and analysis of video records did not reveal varied methodologies used during the teaching of mathematics. Findings of the present research study on how critical thinking skills can be taught to young learners during the teaching of mathematics are therefore limited.

In a research study conducted in Chicago, Beilock (2017) notes that social constructivists encourage learners to engage in dialogue both with the teacher and amongst each other. The use of different methodologies in teaching young learners is therefore likely to promote the development of critical thinking skills through exploration with teaching resources and through interaction with the teacher as well as interaction with peers in learning situations. In a research study which analysed the Turkish early childhood education curriculum, Incikabi and Tuna (2012) emphasised the importance of young learners' mathematics learning by applying learner-centred approaches such as plays suitable for their development. The results of the aforementioned research study indicated that behaviours such as counting, subtracting, and adding and other mathematical behaviours were shown in learners' play. Insights drawn from the responses given by teachers of young learners indicate that play may be used as a vehicle for teaching critical thinking skills during mathematics lessons or activities.

6.4 Why is there a need to teach critical thinking skills to young learners?

The present research study established that some of the interviewed teachers were of the view that critical thinking should be taught to young learners since it is necessary in problem-solving both in school and in real-life situations. Several participants indicated that it is necessary to teach critical thinking skills since they assist with real-life problem-solving. Choy and Oo (2012) maintain that when one is teaching critical thinking skills, the goal is to enable learners to recognise where that particular skill might be appropriate in real situations.

6.4.1 Problem-solving

In another research study conducted in Bangladesh, Islam (2015) revealed that critical thinkers usually have the comprehensive skills to consider all possible options and solve problems. From the aforementioned research study, it may be deduced that, if young learners are taught critical thinking skills, they will be better able to solve problems in their lifelong learning since understanding of concepts is enhanced and mathematical literacy is likely to be improved. Similarly, Carden and Cline in their (2015) Hungarian research study report the Hungarian description of problem-solving as significant to learners' ability to translate formal educational experience into skills for latter life or everyday life. Merely having knowledge or information is therefore not enough. Many participants in the interviews indicated that it is necessary to teach critical thinking skills to young learners since they assist with real-life problem-solving skills. Solving real-life problems is very important and requires a high level of thinking, but can actually be learned (Nio, Sukestiyarno, Waluya, Isharto & Manullang, 2017). This is in line with a study conducted by OECD (2013) which noted critical thinking and problem-solving as some of the 21st century competencies needed in young learners. The importance of teaching critical thinking skills to enhance problem-solving in young learners has also been noted in observations made under Lesson observation 18 during mathematics lessons where learners thought of alternatives as way out of the challenges encountered. The study revealed that some learners might have engaged in critical thinking by concluding that 3-5 is impossible or by finding what was got at night when there was no slot for the night. The present study accredits the involvement of critical thinking skills in using acquired mathematics concepts to solve real-life problems (mathematical literacy).

The findings of this research study are in line with other studies (Griffin, 2012) which noted that critical thinking and problem-solving are some of the 21st century competencies needed in the

young learners. Similarly, the need to teach critical thinking for young learners to solve problems is in line with the views proposed by Kong (2015) who submits that critical thinking skills are processes that enable a learner to develop an argument or solve a problem. It also emerged from this research study that critical thinking skills are necessary for problem-solving and therefore critical for young learners to acquire at an early age for them to improve their mathematical literacy.

The need to teach critical thinking for young learners to solve problems was also realised through observation of mathematics lessons and mathematical activities. The finding of this research study concurs with a Columbian study conducted by Melo (2015) which established that application of what is learnt indicates some degree of critical thinking. Based on the aforementioned research, the present research study therefore acknowledges that fostering critical thinking skills in young learners during the teaching of mathematics may enable learners to apply what they have learnt beyond the classroom context, that is, mathematical literacy.

6.4.2 Mental agility

In an American research study conducted by Goldstone and Day (2012), it was established that learning without transfer of what has been learned is almost unproductive and insufficient (mathematical literacy). In fact, Ancill (2014) admits that critical thinking is much more than just logical reasoning as it is also more than a set of skills or processes. Teachers ought to implement daily activities to enhance high-level mathematical tasks and higher levels of learning by creating higher standards and better measures in order to develop learners who can think more critically (Rothman, 2012). This may imply that activities that foster critical thinking skills should be taught to young learners during mathematics lessons and activities for them to be mentally agile since mental agility is related to critical thinking. It has been also revealed from this research study that mental agility is necessary in learners' learning as well as in their life. A research study in the USA carried out by Graham (2015) noted that the ability to learn, practice and analyse is at the heart of critical thinking and may be critical to closing the wisdom gap in the country. This implies that activities that foster critical thinking skills should be taught to young learners during mathematics lessons and activities for them to be mentally agile since mental agility is related to critical thinking.

Social constructivists believe that learning occurs when individuals are engaged in activities such as interaction and collaboration (Doise, 2015). In view of this, a young learners' mental agility or functioning is likely to be stimulated through critical thinking and, in turn, improve their mathematical literacy through interacting with teachers and engaging in activities with their peers. The present research study established through interviews that critical thinking is an essential asset for further education and even for the future. The finding of this research study is consistent with an American research study conducted by Crockett (2016) who established that critical thinking skills are invaluable because they allow young learners to deal practically with problems of a social, mathematical and scientific nature. In the aforementioned research study, it was also emphasised that it is easy to see why critical thinking skills are important to success beyond school because young learners are empowered to make effective and well-informed decisions in their lives. Draper (2013) argues that the social constructivist approach does not see a classroom as a place where the teacher pours knowledge into passive learners but emphasises active involvement in which young learners interact to create knowledge and acquire skills for everyday use and these may include mathematical literacy.

6.4.3 Lifelong learning

Davies and Barnett (2015) are of the view that the term critical spirit is used in association with this concept (critical thinking) and is defined as the inclination, or disposition, to think critically on a regular basis in a wide range of circumstances. Based on the given views, teaching critical thinking is important for lifelong learning and for use in other circumstances that are encountered in life. The current research study further reveals that critical thinking fosters mathematical literacy in young learners by affording them the power to define solutions to problems and providing them with a platform for reasoning. The finding of the present research study shows that it is important to teach critical thinking to young learners during the teaching of mathematics to enhance their mathematical literacy. Failure to display mathematical literacy by young learners demonstrates the inability by teachers to facilitate the development of critical thinking skills

6.4.4 Defining solutions

Results of the present research study indicate that critical thinking fosters mathematical literacy in young learners by affording them the power in defining solutions to problems and providing a platform for reasoning. Ability by young learners to find the number of books for 30 learners each

having 5 books is likened to use of critical thinking skills to relate learnt mathematical to their everyday experiences. Young learners could have involved critical engagement to find the number of legs for 4 chairs in a class. In a Ugandan research study, Almendrala (2016) noted that in testing treatments of more than 15,000 young learners who participated in the trial, the researchers probably did not consider the effects critical thinking may have on other parts of young learners' life since no activity was done in relation to the development of mathematical literacy. This seems to be an area for concern because some observed mathematics lessons in the current research study were dominated by a lot of chorusing of answers without fully integrating activities that could engage critical thinking skills in the young learners during the teaching of mathematics so as to promote mathematical literacy. The study at hand attributes the criticality of young learners to making use of acquired mathematical knowledge or concepts to solve problems (mathematical literacy). Once having acquired critical thinking skills, young learners may use them not only at school but also in further learning or in different situations in life (mathematical literacy).

6.4.5 Mathematical literacy

The present research study reveals how some of the teachers' questions were likely to promote critical thinking for learners to improve their mathematical literacy. The observations made indicated that teaching critical thinking skills is necessary for mathematical literacy. Analysis of video records and observation of teachers teaching mathematics indicated very limited incidences were teachers engaged young learners in critically utilising acquired mathematical knowledge to make sense of the world around them. In another research study conducted in America, Galinsky (2017) noted that there is no one strategy to support and teach young learners how to think critically but an adult's role may sometimes be that of asking open-ended questions to guide the learners' thinking process. Observations in the current research study revealed that, as teachers were striving to deliver the content, some gave young learners story sums. It seemed as if mathematical literacy was being fostered in the learners since some of them were showing understanding by the answers they provided. Use of dragon fly wings in learning sets and use of a number line with huts to find numbers nearer 10 are some examples which reflected mathematical literacy. Shen (2012) asserts that at the heart of teaching critical skills is the ability to ask learners the right questions.

6.4.6 Questioning

This research study identifies the need to teach young learners critical thinking skills during the teaching of mathematics for the young learners to become mathematically literate. Ramezani, Larsari and Kiasi (2016) acknowledge that the Greek Philosopher, Socrates' teaching practice and probing questioning method, known as the Socratic questioning, is the best-known strategy and technique for fostering critical thinking skills in young learners. This exhibits the importance of questioning in fostering critical thinking skills in young learners during mathematics lessons or activities. From the given views, it maybe deduced that, for young learners to be mathematically literate, they should be taught critical thinking. Teaching young learners critical thinking skills is thus likely to enable learners to convert mathematical knowledge or content to its use in daily life situations (mathematical literacy).

Concurring with the finding of the present research study are Butera, Friesen, Palmer, Lieber, Horn, Hanson and Czaja (2016) who conducted a research study in Reston and established that teaching young learners to solve problems and engage in critical thinking in the context of mathematics instruction requires a series of thoughtful and informed decisions. Critical thinking skills are therefore useful for young learners not only at school but also in everyday life (Darwaman, 2016). Basing on Darwaman's standpoint and the findings of the present research study, learners do not learn critical thinking skills for the sake of solving mathematical problems at school but may use them in further education or in different situations in life (mathematical literacy).

The present research study also noted that some participants asked questions that reflect learners' real-life experiences which are most likely to enhance their critical thinking skills and improvement in their mathematical literacy. Topoglu (2013) notes one of the most important goals in the education of young learners as that of raising individuals who have critical thinking skills and who can make use of those skills in everyday life (mathematical literacy).Burns (2012) realised that not asking young learners to explain and justify their mathematical thinking was wrong since there might be incorrect mathematical reasoning involved that does not provide them with a clear and solid understanding of mathematical concepts. Responses from interviewees and observation of mathematics lessons indicate that there is a need for teaching critical thinking skills when teaching mathematics since this may result in mathematical reasoning. The responses indicating

learners' mathematical reasoning are presented under Lesson observation 16 and 17 of the present research study.

6.4.7 Mathematical reasoning

The National Council of Teachers of Mathematics (NCTM, 2014) admits that mathematics learners who develop critical thinking skills by communicating their thoughts and justifying their reasoning most likely become better critical thinkers and problem solvers. An action research on the development of critical thinking skills conducted by Professor Cossette at Franklin Pierce University in 2013 notes that, from a point of view of questioning the accuracy of information, it (critical thinking) may allow young learners to develop skills necessary to understand different points of view. From the aforementioned research study, it can be deduced that there is, therefore, a need to teach critical thinking skills to young learners during the teaching of mathematics since this is likely to aid in their mathematical reasoning. Learners would thus be making critically reasoned decisions and judgments rather than merely regurgitating information and returning data that comes their way.

Consistent with the need for critical thinking skills to young learners for mathematical reasoning is a study conducted by Aubrey, Ghent and Kanira (2012) which reveals that critical thinking is an important element of mathematical literacy necessary for justifying one's mathematical reasoning. Beilock (2017) acknowledges that social constructivists believe that handling physical materials extends their sensory experiences and this may facilitate mental reasoning which may also lead to critical thinking.

6.4.8 Transfer of learning

A research study by Cossette (2013) revealed that, without the ability to think critically, young learners are ill-equipped to handle many situations in which critical thinking skills are required. It also emerged from observation of mathematics lessons and activities that it is necessary to teach young learners critical thinking skills because it assists them not only during the teaching of mathematics but also in transferring what they have learnt to solve problems they encounter in real-life situations. Some of the actions by young learners noted by the researcher during

mathematics lessons could have involved critical thinking in defining solutions to challenges they encountered in working out mathematical problems.

This research study reveals that the way learners reacted when solving problems could be a result of having used their critical thinking skills to find a way out of their challenges. Along similar lines, Clark (2013) believes that mathematical literacy involves more than executing mathematical procedures; as it involves applying knowledge, methods, and processes in various real-life contexts. On the same note, Denhere (2014) suggests that most people enter the world of work hardly able to transfer learning to real-life situations and this has been attributed to failure by teachers to make learners master the content by encouraging real-life learning. This study identifies a need that, after having taught a certain mathematical concept, learners must be exposed to situations where they can exercise their critical thinking skills and make use of that knowledge in real-life situations, that is, mathematical literacy.

The observations revealed that it is necessary to teach young learners critical thinking skills because it assists them in their learning of mathematics and transfer of what they have learnt to solve problems they encounter. Critical thinking skills in young learners determine how they define solutions to their problems. Aubrey, Ghent and Kanira (2012) acknowledge that literacy includes applying knowledge, methods, and processes in various contexts in meaningful, real-life situations meaningfully.

6.4.9 Mathematical understanding

The present research study also established the necessity to teach young learners critical thinking skills to enhance their mathematical understanding. Critical engagement by young learners during the teaching of mathematics could have enhanced mathematical understanding. Probing young learners to go further than a superficial answer and asking how they got the answer could have assisted young learners to analyse and critical think and make sense of mathematics. The interview data in the present research study saw teachers justifying the need to teach critical thinking to enhance learners' understanding of concepts. Rothman (2012) maintains that one of the expectations for young learners is that all learners achieve mathematics literacy by understanding the content and applying their knowledge to think critically in order to solve complex problems. In trying to define mathematical literacy, participants suggested that young learners ought to

understand concepts so as to transfer knowledge in the day to day use. Additionally, the finding of the current research study is in line with a study conducted in Santa Rosa by Muenzenmaier and Rubin (2013) who confirm that instruction that does not include analysis, synthesis and evaluation does not give learners the chance to think critically enough about what they are learning. Failure to involve higher order thinking skills is therefore likely to make young learners fail to recognise when to apply their knowledge (mathematical literacy).

In another research study conducted in Alabama by Styron (2014), it was established that those teachers who are able to discern learners' level of thinking and use it to construct knowledge, help them to develop better understanding of content. Studies by different researchers such as Malmir and Shoorcheh (2012), Sanavi and Tarighat (2014) recognised the impact of possible relationships between critical thinking and other concepts and skills. The findings of this research study highlight the importance of teaching critical thinking skills to young learners during mathematics lessons or activities to foster mathematical literacy since understanding of concepts is likely to enhance the ability to use the skills in real-life situations.

6.4.10 Distinguishing

The observations made during mathematics lessons saw young learners managing to distinguish the different shapes that were provided. Hintz (2014) is of the view that mathematical communication allows learners to learn different strategies from fellow learners and this is helpful in consolidating thinking while developing a deeper mathematical understanding. Bruner (1966) believes that understanding is seeing relationships and connections with other things that learners know.

The finding of the present research study shows that young learners could have engaged critical thinking to establish mathematical understanding by associating what they know to what they were learning. This is in line with the findings of a Colombian research study conducted by Scheau (2012) which concluded that critical thinking skills are necessary because they increase learners' imagination, active behaviour and immediate application of different skills. Based on the aforementioned study, the present research study acknowledges the necessity to teach critical thinking skills during teaching of mathematics to enable learners to associate what they learn to the real world (mathematical literacy).

6.4.11 Mathematical understanding

The research study indicates that some young learners could have engaged criticality to establish mathematical understanding by associating shapes to what they already know from their experiences. In the Columbian research study, Melo (2015) established that learners develop personality characteristics such as the ability to distinguish according to the learning approaches they experience in school. Topoglu (2013) suggests that teachers ought to provide meaningful activities in which learners manipulate and interact with the environment for them to critically make major connections to the world. It has been established by the present research study that critical thinking skills are necessary for learners to see the relationship of what they have learnt to other things in their environment (mathematical literacy).

6.4.12 Independent thinking

The findings from both in-depth interviews and observations of lessons and activities have shown that it is necessary to teach young learners critical thinking skills for them to become independent thinkers. This was shown by learners' actions in which some young learners made decisions to engage others to work out individual problems. Distributing exercise books when not assigned to do so and reciting a rhyme while tasked to sort colourful objects are characteristics of independent thinking. It can be added that such actions were most likely to have emanated from their critical thinking skills. The finding of this research study is related to a research study conducted by Kopzhassarova, Akbayeva, Eskazinova, Belgibayeva and Tazhikeyeva (2016) in Kazakhstan which established that a person's independent thinking is one of the primary conditions of developing critical thinking. The study further deduced that teaching young learners' critical thinking skills during the teaching of mathematics could be a necessity to nurture independent thinking which, in turn, may result in improvement in young learners' mathematical literacy.

In a research study conducted in the United Kingdom, Loh (2017) studied child brain and development and noted that there are a number of skills that young learners should learn and master to become successful in life. One of the skills proposed in the aforementioned study is that learners should find their own solutions or answers to problems. According to Lin (2013), critical thinking is a mental process that is well-organised and plays a role in the decision-making process to solve the problem by analysing and interpreting data. Teaching young learners critical thinking skills

during the teaching of mathematics could be viewed as a necessity since it has proved to promote independent thinking, improve mathematical literacy several other outcomes.

6.5 Conclusion

In this chapter, the findings of the present study are presented in the context of the three study research questions which focus on factors related to the teaching of critical thinking skills. The study has provided answers to how critical thinking skills are taught and why there is a need to teach young learners critical thinking skills. The data was discussed and substantiated with literature from both national and international studies to support the findings that rose in the current research study. Conclusions of this research study, from which new knowledge is drawn, are presented in the subsequent chapter. Furthermore, a model which summarises the whole research study is also proposed in the next chapter.

CHAPTER 7: CONCLUSION OF THE RESEARCH STUDY

7.1 Conclusion

The focus of this research study was to find out factors related to the teaching of critical thinking skills to young learners, how critical thinking skills are taught to young learners during the teaching of mathematics and why there is a need teach critical thinking skills to young learners. The chapter concludes the research study by presenting a summary of the findings on each research question, limitations of the study, contribution of the study, recommendations and suggestions on issues requiring further research.

7.2 What Factors Are Related to the Teaching of Critical Thinking Skills?

The findings of the present research study indicated that there are several factors that are related to the teaching of critical thinking skills to young learners in the Zimbabwean context. Some of the factors noted are chronological age, mental age, culture, communal influences, technological influence, and socio-economic status of parents, availability of emotional support, reinforcement of schoolwork performance, gender and age. These factors have been revealed to have an influence on the teaching of critical thinking skills to young learners during mathematics teaching to promote their mathematical literacy. The factors have been noted to influence the teaching of critical thinking skills mainly in the negative rather than positive.

7.2.1 Chronological age

The research study finding showed that chronological age is related to the teaching of critical thinking skills to young learners. The results from interviewed teachers indicated that critical thinking skills develop as the learner grows chronologically to explore the environment widely. As presented in Chapter 5, observation of young learners engaged in activities revealed that 8-year olds displayed better critical thinking characteristics as compared to the 3-7-year olds. Based on this finding, the present research study assumes that, as children grow older, cultural behaviour traits that stifle the development of critical thinking skills are diminished. Diminishing cultural behaviour traits in young learners could have created opportunities for 8-year olds to exhibit better critical thinking characteristics than those younger than them.

7.2.2 Mental age

Results from interviewees revealed that mental age does not inhibit the development of critical thinking skills as long as the work given to learners is within their developmental level. The study indicated that mental age has an effect on the development of learners' critical thinking especially when their cultural backgrounds interfere with teaching and learning. Based on social constructivist epistemology which guides this study, learners could have critically engaged in activities if those at lower mental level were assisted by those at a higher mental level. It was established through observation in this research study that, when mental age increases, learners approach the concept of critical thinking more broadly than when they are still at an elementary age.

7.2.3 Adult influence

The research findings in this study established that several factors pertaining to learners' culture may influence the development of their critical thinking skills. It emerged from the research study that adults may impede the development of critical thinking skills by not providing young learners with the opportunity to think critically. The adults appear to limit learners' exposure to situations that enhance critical thinking. It also emerged from the study that the upbringing of learners may engender negative attitudes towards certain customs which may inhibit critical thinking skills. Socialising young learners not to speak in the presence of the adults could have interfered in teaching critical thinking skills during the teaching of mathematics right across all age groups under study.

7.2.4 Community influence

It was revealed in this research study that the community influences learners' development of critical thinking skills. The research study findings indicated that there are cultural dimensions that may have an impact on learners' development of critical thinking skills either positively or negatively. The research study has shown that teachers take into consideration what the community expects of learners in teaching and learning situations. Some expectations of the community may stifle the development of critical thinking skills of young learners since they could be thinking along the expectations of the community. By abiding by the expectations of the community, young learners could not be expected to have gone further than the predictable norm. Results from

observations reveal several incidences when learners were asked to speak up during the teaching of mathematics. Failure or reluctance to speak up is not a characteristic of critical thinking.

7.2.5 Technological influence

The research findings in this study indicated that there was complete absence of technological tools during the teaching of mathematics right across all the age level under study. Exploration with technological tools during the teaching of mathematics could have accorded young learners better chances of engaging in critical thinking skills. However, observations of all 25 teachers in the research study did not show evidence of use of technological resources in the teaching of mathematics. Instead of using technological resources in teaching young learners, the teachers in the research study resorted to use of work cards and rarely infused technological tools in the teaching of mathematics. Observations rather revealed teachers resorting to the use of counters during the teaching of mathematics. Absence or failure to use technological resources during the teaching of mathematics could have compromised the development of critical thinking skills to promote mathematical literacy. As presented in Chapter 5, the lack of technological resources in learners' home backgrounds could stifle their critical thinking skills while the availability of technological resources at home could stimulate the development of their critical thinking skills to promote mathematical literacy.

7.2.6 Parents' socio-economic status

Lack of exposure to a variety of educational objects or environments has been noted to stifle learners' critical thinking skills because of want of stimulation. On the other hand, the availability of resources in learners' homes has been established as stimulating their critical thinking skills because it gives them an opportunity to interact with resources and therefore facilitate the development of such skills. The findings also suggest that young learners from families of better economic status are highly motivated and likely to be better critical thinkers than those from poor home backgrounds where learners' critical thinking skills are stifled by low self-esteem. Failure to provide stimulating environments and resources by parents could be accredited to why young learners did not explicitly display critical thinking skills during the teaching of mathematics.

7.2.7 Intellectual support

The research study indicated that teachers of young learners have mixed views on the effects of intellectual support from learners' backgrounds. Some of the teachers in the research study

revealed that learners' critical thinking skills are suppressed by some adults who do not provide them with an opportunity to present their own ideas or views on certain issues. Asking young learners to be silent or to make less noise and then asking them to speak up in another moment could be attributed to cognitive dissonance which, by extension, could have resulted in failure by young learners to explicitly display critical thinking skills. One would suggest that limited critical thinking characteristics during activities were demonstrated by limited intellectual support from teachers. Other teachers in the research study also indicated that every learner can think critically despite coming from a poor background. The fact that every learner has the potential to think critically shows that learners need to be supported by both parents and teachers for them to develop critical thinking skills.

7.2.8 Emotional support

The current research study established that emotional support offered by families to learners has an impact on the acquisition of critical thinking skills during the teaching and learning of mathematics It has been deduced from interview excerpts that without emotional support learners from poor family backgrounds may fail to critically engage in activities due to a lack of self-esteem while learners from better family backgrounds could be highly motivated to engage in critical thinking. The research study revealed that learners are likely to think critically if they are in a good emotional state. Six (24%) out of the twenty-five teachers in the research study were observed providing emotional support to some of the learners to assist them to think critically during the teaching of mathematics.

7.2.9 Reinforcement of schoolwork

The research study established that reinforcement of schoolwork has an impact on the teaching of critical thinking in young learners to promote mathematical literacy. The research study noted the limited reinforcement such as the provision of resources by both teachers and parents. It was revealed that some young learners came from families where there was no one to encourage them, assist them to do homework or ask them about schoolwork. Research findings revealed that some parents did not place importance on schoolwork and allowed their children to miss school. All this could deprive young learners an opportunity to think critically as they miss mathematics classes.

7.2.10 Gender equality

The research study revealed that every learner has a potential to think critically despite gender. Contrary to this view, a research study by Rutoro (2013) noted some cultural misconceptions or fallacies especially in the Shona culture where men are regarded as fast thinkers, problem-solvers and rational thinkers whereas women were considered to be slow thinkers, poor at solving problems and prone to irrational thinking. Fourteen (56%) out of twenty-five teachers in the present research study indicated that critical thinking has nothing to do with gender since being a boy or a girl does not matter. All (100%) twenty-five teachers in the research study were observed teaching boys and girls the same content and using the same teaching strategies. However, some gendered misconceptions about boys and girls are likely to stifle the development of critical thinking skills in girls while such skills are fostered in boys because young learners are believed to live according to the expectations of society. Refusing to hold hands with boys to make a circle could inhibit social interaction in which boys and girls critically share experiences during the teaching of mathematics.

7.2.11 Gender differences

Some teachers in the research study indicated that boys and girls are socialised differently and have different preferences. The research study by Rutoro (2013) noted that, in the Zimbabwean context, they are misconceptions in the Shona culture that are held as truth sand which may affect the ability of boys and girls. The present research study established that boys are exposed to a variety of activities which are likely to enhance critical thinking skills. Nine (36%) out of twenty-five teachers in the research study indicated that boys and girls are naturally different and believe that boys are better thinkers than girls. However, fourteen (56%) out of twenty-five teachers observed in the research study did not consider gender in their teaching since they exposed young learners to the same activities, marking the same items and even sit together in groups. The results indicate that no differences were observed between boys and girls during the teaching of mathematics. Thus equal opportunities for developing critical thinking skills during the teaching of mathematics were created right across all the age groups in question.

7.2.12 Paradigm shift

The research study revealed that, in contemporary society, the focus of people has shifted from giving boys first preference to attend school to appreciating the education of girls. It emerged from

the research study that, even though some people still consider that girls should go to school up to a certain level, they are now very few people with such beliefs. Four (16%) out of twenty-five teachers indicated that there are no gender differences in critical thinking any longer because most people now know the importance of education for both their male and female offspring without any gender bias.

7.2.13 Difference in age

The research study revealed mixed feelings from teachers on whether a difference in age is related to the teaching of critical thinking skills in young learners. Eight (32%) out of twenty-five teachers indicated that learners' critical thinking skills vary with age while others believe that the difference in age does not matter. Results presented in Chapter 5 on young learners engaged in activities revealed that thinking critically, in terms of age difference, could be a result of culture. One could deduce that learners' culturally related behaviour traits, which could have interfered with the development of critical thinking skills, diminish as they progress through their age levels. Better chances of developing critical thinking skills during mathematics teaching are created as the inhibiting cultural behaviour traits shade off.

7.3 How are critical thinking skills taught to young learners?

The present research revealed the importance of both learner and teacher activities in enhancing critical thinking skills to young learners.

7.3.1 Teacher activities

It emerged from this research study that Zimbabwean teachers were not the crucial players in facilitating young learners' critical thinking skills during the teaching of mathematics. Seventeen (68%) out of twenty-five teachers indicated that they provide a lot of activities to cultivate learners' critical thinking skills. The results indicated that teachers claimed to use several activities to nurture learners' critical thinking skills. Proposed activities included provision of mental activities in which young learners worked together or individually, asking questions that were not directly linked to the lesson and asking them to solve problems that may be found in their daily lives. Even though teachers claimed to have given such activities to develop young learners' critical thinking skills to promote mathematical literacy, very few characteristics related to critical thinking were observed.

7.3.2 Learner activities

Twenty-two (88%) out of twenty-five teachers in the research study indicated that teachers should provide teaching resources that stimulate the development of critical thinking skills in young learners. It also emerged in the research study that teachers sought to make use of varied resources during the teaching of mathematics so that young learners could explore some mathematical facts. Six (24%) out of twenty-five teachers in the research study proposed learner-centred activities such as writing story sums, probing learners, tackling problematic situations, writing mental sums, writing spellings, and working in groups as well as working individually. The research study revealed that there was active engagement in which young learners freely interacted with peers as well as with technological teaching resources that influence the development of critical thinking and everyday application of mathematics (mathematical literacy).

7.3.3 Teaching methodology

The research study further revealed that teachers ought to make use of different teaching methods in the teaching of mathematics in order to promote critical thinking in young learners. Five (20%) out of twenty-five teachers indicated that they make use of different teaching methods such as discovery trips, opportunities to do creative drawing or own choice drawing, and encouraging young learners to provide full explanations during lessons or activities as well as providing learners with the opportunity to chant rhymes that are in line with problems that need to be solved. Results from observations made during the teaching of mathematics did not reveal much in terms of methodologies teachers used to facilitate the development of critical thinking skills in the young learners during the teaching of mathematics. The results indicated that findings on the methodologies employed in teaching critical thinking skills to promote mathematical literacy are very limited.

7.4 Why is there a need to teach critical thinking skills to young learners?

The present research study established that there are several reasons why critical thinking skills should be taught to young learners. The research findings in this study revealed that critical thinking ought to be taught to young learners to promote problem-solving, mental agility, lifelong learning, and mathematical reasoning, giving solutions to problems, understanding concepts, ability to distinguish and to foster independent thinking. The subsequent sub-sections present the

summary of the findings on each of the noted reasons for teaching critical thinking skills to young learners.

7.4.1 Nurturing critical thinking to enhance problem-solving

It emerged from this research study that critical thinking skills ought to be taught to young learners since they are necessary in problem-solving. Nine out of twenty-five teachers indicated that it is necessary to teach critical thinking skills to young learners since these skills are essential in solving real-life problems. Some of the teachers (36%) indicated that, if one does not have critical thinking skills, he or she cannot solve problems when the need arises. It has also been revealed through observation that, for learners to be able to solve problems, they must have critical thinking skills which should be nurtured in them whilst they are still young. They are very few cases where young learners were observed using critical thinking skills to solve real-life problems during the teaching of mathematics. The research study established that fostering critical thinking skills in young learners during teaching mathematics is necessary as it enables them to critically apply what they would have learnt beyond the classroom context (mathematical literacy).

7.4.2 Encouraging critical thinking skills to enhance mental agility

It was revealed through this research study that young learners should have critical thinking skills for them to be mentally agile. Six (24%) out of twenty-five teachers indicated that learners' critical thinking improves their question tackling skills such that when they face problems, they can answer without difficulties. Other teachers have shown that, if learners have critical thinking skills, they also develop other different skills such as ability to analyse. The research study has revealed that activities that foster critical thinking skills should be taught to young learners during the teaching of mathematics for them to become mentally agile.

7.4.3 Promotion of critical thinking skills to enhance lifelong learning

The research study revealed that critical thinking skills are necessary for further education and lifelong learning. The findings indicated that, if young learners are not taught how to think critically at an early age, it will not just materialise when they are in upper grades. Nine (36%) out of twenty-five teachers indicated that critical thinking skills assist young learners to use their intelligence throughout their education and life. It was also shown that young learners use these skills latter in examinations as well as after having completed school. The research study revealed

the necessity to teach young learners critical thinking skills since they are likely to utilise them in lifelong learning as well as in real-life situations in the future.

7.4.4 Development of critical thinking skills to promote mathematical literacy

The research study has shown that there is a need to teach young learners critical thinking skills since they are not only necessary in school, but also useful in everyday life, that is, mathematical literacy. Twelve (48%) out of twenty-five teachers indicated that critical thinking skills are necessary to young learners for they are part and parcel of their lives. Other teachers expressed the necessity for learners to have critical thinking skills so as to apply the learnt mathematics concepts to solve problems they encounter (mathematical literacy) in life. It also emerged from the study that, with critical thinking, learners would be able to survive with easy in the contemporary environment since mathematics is something which they experience every day. The research study revealed that young learners do not learn critical thinking for the sake of solving mathematical problems at school but to use the skills in their learning in the future or in different situations in life, that is, mathematical literacy. Two (8%) out of twenty-five teachers in the research study were observed giving real-life mathematical problems in which young learners used critical thinking skills to solve the given problems.

7.4.5 Fostering critical thinking skills to enhance mathematical reasoning

The research study revealed that fostering critical thinking skills in young learners assists in mathematical literacy reasoning. Two learners were observed responding to the teacher's questions giving reasons why they have adopted their answers or how they got the answers. The research study thus revealed that critical thinking skills are important in enhancing learners' mathematical reasoning.

7.4.6 Developing critical thinking skills for defining solutions

The present research study indicated that there is a need to teach young learners critical thinking skills since these assist them to transfer mathematical knowledge to solve problems they encounter in real-life situations. The young learners were observed applying critical thinking skills to solve problems encountered during the teaching of mathematics. It also emerged from the research study that critical thinking skills are necessary for transfer of knowledge by young learners to get solutions to problems they encounter in real-life situations.

7.4.7 Stimulation of critical thinking skills to enhance the understanding of concepts

The research findings of this study also revealed a need to teach young learners critical thinking skills to enhance their mathematical understanding. Nine (36%) out of twenty-five of the interviewed teachers indicated that young learners should have critical thinking skills for them to understand mathematical concepts as some of them need thinking. Five out (20%) of twenty-five teachers indicated that critical thinking skills enable young learners to quickly grasp concepts when learning mathematics. The teachers envisaged that teaching young learners critical thinking was would enable them to understand mathematical operations involved in day to day use, that is, mathematical literacy.

7.4.8 Improving critical thinking skills to enable learners to distinguish what they are experiencing to what they already know

The present research study revealed that young learners think critically by associating what they already know with what they are learning. It emerged from this research study that young learners have the ability to see relationships and connections of what they are learning to other familiar things. Learners associated a triangle with a roof of a hut, a grass thatched hut and a shed. A circle was also associated with a ball while a square was associated with a box. All the associations or distinctions made by young learners during the teaching of mathematics were noted to have been evoked by their critical thinking skills.

7.4.9 Empowering learners with critical thinking skills to enhance independent thinking

The findings of the present research study revealed that there is a need for learners to acquire critical thinking skills for them to become independent thinkers. It was observed that learners could make decisions without teachers' intervention. The use of critical thinking skills was also realised when one learner converted wooden blocks, which he was assigned to use for construction, into clappers used in music and dance. Critical thinking was considered by Lipman (1991) as the forming of judgments based on criteria or reasons. Thus, by putting wooden blocks to a different use, the learner thought independently from what has been instructed and came out with another valid use of the wooden blocks. In critical thinking, learners build on other people's contributions to give opinions and imagine alternatives (Gorard, Siddiqui& See, 2015).The present research study revealed that young learners have the ability to think critically to come up with independent decisions.

7.5 Limitations of the study

The following are some of the limitations of the study which need to be considered in future studies:

The empirical study was confined to only one District of Zimbabwe, namely Zaka District. The findings of the research study therefore cannot be generalised to the whole of Zimbabwe since only five schools in Zaka District where sampled conveniently for the research study.

The research study employed the qualitative approach only. The qualitative approach was found to be reliable when dealing with teachers and young learners. However, more insights might have been drawn from mixed methodologies. In the case of the present research study, the questionnaire could have complemented the interviews and observations.

The theoretical framework used to explore the teaching of critical thinking skills is more of a social perspective useful in situated learning rather than of a cognitive nature which engages structures, concepts and procedures.

7.6 Contributions of the study to the field of knowledge

In spite of the aforementioned limitations the present research study is the first of its kind to explore the teaching of critical thinking skills to young learners during the teaching of mathematics from a Zimbabwean context. The body of knowledge in situated learning in the development of critical thinking skills to promote mathematical literacy is enriched by adding data from this Zimbabwe-based study. It is likely that the research study will extend the breadth and depth of the body of knowledge in the education of learners in the 3-8years age bracket.

The knowledge on culture as a major influence in teaching young learners critical thinking will assist ECD stakeholders to strategize in resolving challenges in teaching critical thinking skills in Zimbabwean primary schools. The stakeholders may include parents, teachers, learners, the community and the government. Such cultural knowledge may assist to circumvent the challenges experienced in early childhood learning and development in Zimbabwe. The study has shown that young learners in Zimbabwe are not benefiting much in terms of critical thinking and mathematical literacy during the teaching of mathematics.

The research study also serves as a starting point for further researches in the field of critical thinking skills with young learners and promotion of mathematical literacy in young learners. Additionally, the present research study brings in a model of teaching from the findings of the study as new knowledge in the field of teaching critical thinking skills to learners in the 3-8-year age bracket.

7.6.1 The proposed model of teaching young learners critical thinking skills to promote mathematical literacy

A model has been proposed emerging from the summary of the findings of this particular research study. The model is grounded within the social constructivist epistemology involving a large social network. There is a symbiotic relationship among different factors that make up the model. All factors focus on promoting learners' critical thinking skills. The pivot for all factors is that learners exhibit different outcomes as a result of their interaction with different factors in the ambits of social constructivism. The different elements of the model are thus interconnected and converge on learners' critical thinking skills which, in turn, results in different outcomes, one of which is mathematical literacy.

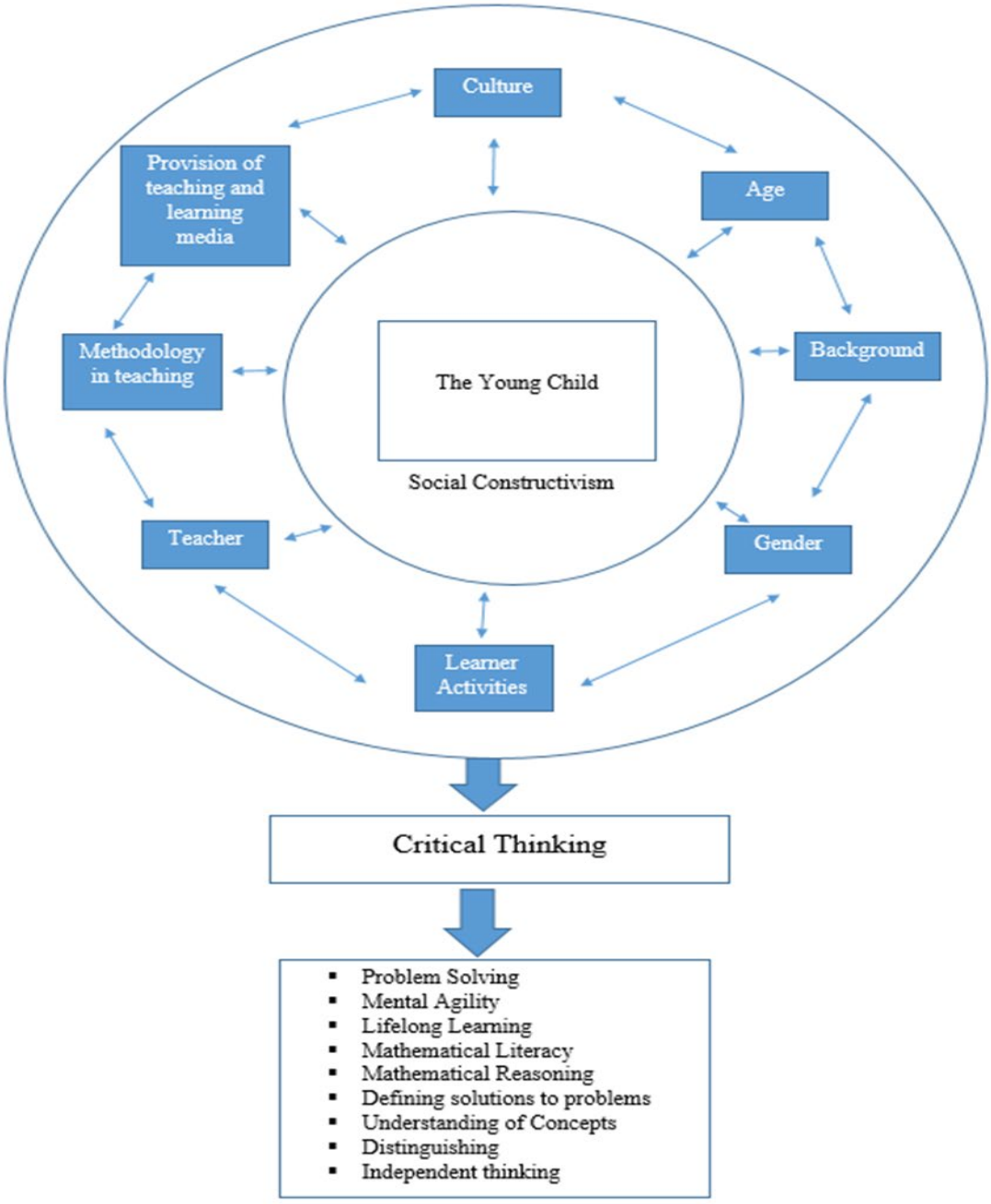

Figure 1: Critical Thinking Model for Learners in the 3-8-Year Age Range.

Based on the model, critical thinking does not develop in a vacuum but through interaction of different variables. The inter-dependence of the different variables in the social ambiance cultivates critical thinking skills in the young learner. The model also reveals that the manifestation and use of critical thinking results in different requisite skills for young learners including mathematical literacy.

7.6.1.1 The young learner

Young learners are central to the whole teaching process, that is, they are at the core of all the teaching under normal circumstances. This research study is hinged on social constructivism in which the learner interacts with different elements that result in the development or acquisition of critical thinking skills by the learner. The proposed model reveals that the acquisition of critical thinking skills by young learner results in the manifestation of different capabilities or skills.

7.6.1.2 Provision of teaching and learning tools

Young learners should be provided with teaching resources to interact with during the teaching of mathematics if they are to acquire critical thinking skills to promote mathematical literacy. The provision of teaching resources depends on the learners' culture and determines the kind of teaching methodologies that the teacher may employ. In the provision of teaching resources, the teacher should also consider the age of learners, their background, gender and the kind of activities that suit the age level of the learner.

7.6.1.3 Culture

Culture has been noted to have a major setback on the teaching of critical thinking skills since it has been noted to influence the teaching of mathematics to young learners. The situation in the home, the kind of resources found in the home, and the expectations of the community have a bearing on the development or acquisition of critical thinking skills by young learners.

7.6.1.4 Age

The learners' chronological age or mental age determines the kind of learning resources that the teacher should provide in the teaching and learning situation. Age is also influenced by learners' culture which might also have its expectations of them. Both age and culture may either promote or stifle the critical thinking skills of learners. The present research study indicated that critical thinking may improve with the increase in chronological age and the provision of age appropriate work to learners is thus necessary..

7.6.1.5 Background

The research study indicated that there are several factors aligned to background as an influence on the teaching of critical thinking skills. Young learners who are exposed to video games, screen time and other electronic devices engage in higher order thinking processes. The research study

has shown that learners' critical thinking skills could be enhanced as young learners interact with technological resources.

The socio-economic status also has a bearing on learners' acquisition of critical thinking skills since the availability of resources is related to how they interact with resources and how teachers facilitate the development of critical thinking skills in them. Lack of resources in learners' homes may stifle the development of critical thinking skills in young learners.

Intellectual support offered by families and teachers through reinforcement of schoolwork may foster learners' critical thinking skills during the teaching of mathematics. Every young learner has a potential to think critically if well supported and lack of support by families may stifle critical thinking skills and development of mathematical literacy in the young learners.

7.6.1.6 Gender

Gender is associated with how young learners are socialised. The way learners from different backgrounds are socialised also determines the kind of activities learners engage in. Gender differences therefore affect how boys and girls think depending on how they are socialised as well as the conceptions and misconceptions held by the community gender roles.

7.6.1.7 Learner activities

The activities that young learners engage in depend on what is expected of them in society. The way the community expects a boy or a girl to behave has a bearing on learners' development of critical thinking skills. The approach that teachers employ also depends on what the community expects of boys and girls. It has been revealed in this research study that there are misconceptions held about boys and girls which may affect the development of critical thinking skills in young learners either positively or negatively.

7.6.1.8 Teacher

Some teachers were observed employing activities and methodologies that are integrated with learners' background or culture. The provision of teaching resources has been seen to be determined by what is locally available. Other teachers were observed using resources from the social context in the teaching of mathematics. The teachers also created opportunities for young learners to work in groups with their tasks and this is in line with the theoretical framework of the present research study.

7.6.1.9 Methodology in teaching

The teaching methodologies teachers employed in their teaching of mathematics depended on the dictates of learners' background, gender expectations and culture. In addition, the methodologies were also determined by the availability of resources as well as the chronological and mental age of learners being taught.

7.7 Recommendations

Based on the findings of the present research study, the researcher recommends ways of improving the teaching of critical thinking skills to young learners in order improve their mathematical literacy. The recommendations correspond with the current practices in early childhood education and development in Zimbabwe. The researcher therefore recommends that:

7.7.1 Policy

There is a need to establish a policy on teaching of critical thinking skills to young learners which is supported by a legislation act. Currently Zimbabwe has no policy that mandates the teaching of critical thinking skills despite the need to teach such skills to young learners. Such a policy requires a wider consultation among early childhood practitioners before it is finalised into a legal document.

The policy should also have provision of services that enhance both critical thinking and mathematical literacy in young learners. A policy on the teaching of critical thinking skills should enforce the learning of mathematical literacy as a standalone subject rather than leaving young learners to acquire mathematical literacy through trial and error during mathematics teaching.

7.7.2 Resources

The education of young learners in early childhood programmes in Zimbabwe would be improved if adequate resources are available since they create opportunities for young learners to explore. Adequate resources, especially those in line with modern technology, should be emphasised in the education of young learners through collaboration with government, communities and or non-governmental organisations.

7.7.3 Parents

The research study revealed that parental involvement in the education of young learners was limited in terms of support due to learners' backgrounds. The research study therefore recommends

that parents could play a more active role in the education of their children. In addition to taking part by paying school fees and providing resources, parents should also assist young learners when they are learning at home. Working together with parents may improve service delivery in the education of young learners.

7.7.4 The teachers

The research study revealed that teachers do not always make use of technological resources in the teaching of mathematics to foster young learners' critical thinking skills in order to improve their mathematical literacy. The teachers who were observed teaching resorted to the use of flash cards instead of technological resources. Due to the findings of this research study, it is recommended that teachers make use of technological resources in the teaching of mathematics so as to nurture critical thinking skills of young learners. Technological teaching resources are likely to enrich highly motivated young learners who have the potential and enthusiasm to think critically.

7.7.5 The young learner

The present research study also revealed that young learners develop their critical thinking abilities through interaction with their peers, teachers, teaching and learning resources. It has also been established in this research study that a young learner needs concrete resources for him to become mentally agile. Young learners would be stimulated to think critically if teachers create opportunities for learners to interact with their peers, teachers and with teaching resources through active involvement.

7.7.6 Teaching methods

This research study established that teachers were using methodologies in which young learners were not actively involved in their own learning. Teachers were not using learner-centred methodologies. An interaction between two or more learners could promote the development of critical thinking skills which in turn may lead to improvement in their mathematical literacy. If teachers would employ teaching methods that cater for active engagement of young learners, their critical thinking skills would therefore be stimulated and their mathematical literacy likely to improve.

7.8 Issues that require further research

The following issues need to be considered for further research in Zimbabwe:

The study only covered five schools in one district. There is need to conduct such a research at national level.

This research study only covered perceptions of teachers in the teaching of critical thinking skills to young learners to promote mathematical literacy. There is need to carry out studies which capture perceptions of other stakeholders such as parents, other teachers in the upper grades, heads of schools and education officers.

The effectiveness of the education of young learners may be determined further by conducting studies on critical thinking and how best to promote mathematical literacy in them.

Since parental involvement has been seen to be low in terms of enhancing learners' critical thinking skills, studies of parent-school relationships should be undertaken with the aim to enhance quality education for young learners.

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APPENDICES

Appendix A: Application to the Ministry of Primary and Secondary Education to carry out research in schools

Morgenster Teachers' College
P.O. Morgenster
Masvingo.

6 April 2015

The Director
Human Resources
Ministry of Primary and Secondary Education
P O Box CY 121
Causeway
Harare

Dear Sir/Madam

Re: Application for permission to carry out a research with ECD teachers and the learners they teach in five schools within Zaka District.

Reference is made to the above-mentioned subject.

I am currently registered for a doctoral Degree in Education with the University of KwaZulu-Natal (UKZN). The thesis I am undertaking is entitled: **"Exploring the Teaching of Critical Thinking Skills to Learners to Promote Mathematical Literacy: A Case of Five Schools in the Zaka District of Zimbabwe"**

Following the Presidential Commission of Inquiry into Education and Training, also known as the Nziramasanga Commission, Zimbabwe saw the establishment of early childhood development (ECD) in primary schools by attaching ECD 'A' and 'B' 'classes for two years, in line with Circular No 14 of 2004. The primary education system now includes ECD learners from 3 to 8 years. Experience in working with young learners has shown that learners develop weak critical thinking skills because of the way they are taught from grassroots. The study seeks to explore the teaching of critical thinking to young learners starting from preschool through age eight in five selected primary schools.

For this reason, permission is being sought to study in the following five primary schools; Muzondidya, Bota, Rudhanda, Mushungwa and Chipezeze in Zaka District. The ECD teachers in the five schools are going to be requested to participate and be interviewed, observed and video- recorded during teaching and learning. The practitioners' participation is going to be entirely voluntary. Anonymity is going to be granted. The participants will not suffer from any harm whatsoever should they decide not to participate or stop participating.

Yours faithfully

Makonye Leah EC No. 0865849 P

1

Appendix: Interview Guide for ECD Teachers

UNIVERSITY OF KWAZULU-NATAL
COLLEGE OF HUMANITIES
SCHOOL OF EDUCATION
DISCIPLINE: Mathematics Education
RESEARCH TOPIC: ***Exploring the Teaching of Critical Thinking Skills to Learners to Promote Mathematical Literacy: A Case of Five Schools in the Zaka District of Zimbabwe.***

SCHOOL A **GRADE LEVEL……..**

1) Briefly describe your understanding of critical thinking skills in young learners.

2) Why is it important to teach young learners critical thinking skills?

3) How are you promoting critical thinking skills in your class?

4) How do the following factors influence the teaching of critical thinking skills in young learners?

   a) Age of the child

   b) Culture

   c) Background of the child

   d) Gender

5) Briefly give your understanding of mathematical literacy.

6) Why should we care about mathematical literacy in enhancing young learners' critical thinking skills?

1

Appendix C: Mathematics Lessons Observation Guide for ECD Teachers

UNIVERSITY OF KWAZULU-NATAL
COLLEGE OF HUMANITIES
SCHOOL OF EDUCATION
DISCIPLINE: Mathematics Education

RESEARCH TOPIC: ***Exploring the Teaching of Critical Thinking Skills to Learners to Promote Mathematical Literacy: A Case of Five Schools in the Zaka District of Zimbabwe.***

SCHOOL A **GRADE LEVEL……..**

Items to be observed	**Learner's Actions**	**Caregiver/Teacher Support**
Reasoning		
Problem solving		
Asking questions		
Decision making		
Distinguishing		
Drawing inferences		
Interpreting		
Defining solutions		

1

Drawing conclusions		
Problem recognition		
Analysing		
Synthesising		
Evaluating		
Independent thinking		

Appendix D: Observation Guide for Learners Engaged in Activities

UNIVERSITY OF KWAZULU-NATAL
COLLEGE OF HUMANITIES
SCHOOL OF EDUCATION

DISCIPLINE: Mathematics Education

RESEARCH TOPIC: ***Exploring the Teaching of Critical Thinking Skills to Learners to Promote Mathematical Literacy: A Case of Five Schools in the Zaka District of Zimbabwe.***

SCHOOL A **GRADE LEVEL……..**

Name of activity	Number of learners	Age or age group	Materials or equipment used	Critical thinking skills observed
Block play, etc.				
Additional tasks				

1

Appendix E: Consent Letter for ECD Teachers

School of Education
College of Humanities
University of KwaZulu-Natal
Edgewood Campus

Dear Participant

INFORMED CONSENT LETTER

My name is Leah Makonye. I am a Doctoral candidate studying at the University of KwaZulu-Natal, Edgewood campus, South Africa. I am interested in exploring the teaching of critical thinking skills in mathematical literacy with young learners. To gather the information, I am interested in observing you teaching mathematics.

Please note that:

- Your confidentiality is guaranteed as your inputs will not be attributed to you in person but reported only as a population member opinion.
- The observation may last for about 45 minutes to 1 hour.
- Any information given by you cannot be used against you, and the collected data will be used for purposes of this research only.
- Data will be stored in secure storage and destroyed after 5 years.
- You have a choice to participate, not participate or stop participating in the research. You will not be penalized for taking such an action.
- Your involvement is purely for academic purposes only, and there are no financial benefits involved.
- If you are willing to be observed, please indicate (by ticking as applicable) whether or not you are willing to allow the observation to be recorded by the following equipment:

Equipment	**Willing**	**Not willing**
Audio equipment		
Photographic equipment		
Video equipment		

I can be contacted at:
Email: leemakonye@gmail.com
Cell: +263 772 620 977

My supervisor is Dr. Jayaluxmi Naidoo who is located at the School of Education, Edgewood Campus of the University of KwaZulu-Natal.
Contact details: email: naidooj2@ukzn.ac.za Phone number: +27312601127.

You may also contact the Research Office through:
Ms P Ximba (HSSREC Research Office)
Tel: 031 260 3587
Email: ximbap@ukzn.ac.za)
Thank you for your contribution to this research.

1

DECLARATION

I…… (full names of participant) hereby confirm that I understand the contents of this document and the nature of the research project, and I consent to participating in the research project.

I understand that I am at liberty to withdraw from the project at any time, should I so desire.

SIGNATURE OF PARTICIPANT **DATE**

…… **……**

SIGNATURE OF PARENT (If participant is a minor) **DATE**

…… **……..**

Appendix: Consent Letter for Parents to Seek Permission to Work With Their Learners

UNIVERSITY OF KWAZULU-NATAL
COLLEGE OF HUMANITIES
SCHOOL OF EDUCATION

DISCIPLINE: Mathematics Education

RESEARCH TOPIC: ***Exploring the Teaching of Critical Thinking Skills to Learners to Promote Mathematical Literacy: A Case of Five Schools in the Zaka District of Zimbabwe.***

Informed Voluntary Consent and Agreement Participation in observation and video recording during teaching and learning.

Hello
My name is Makonye Leah. I am a doctoral student with University of KwaZulu-Natal (UKZN). My thesis is entitled: "*Exploring the Teaching of Critical Thinking Skills to Learners to Promote Mathematical Literacy: A Case of Five Schools in the Zaka District of Zimbabwe*". For data generation, you are being requested to allow your child to participate in a lesson observation that include video recording during teaching and learning.

The aim of the observation and video recording is to establish the teaching of critical thinking skills with young learners. Please understand that your child's participation is entirely based on your wish. The child will not suffer from any harm whatsoever during the process. Should you decide to stop your child from participating in this research study the researcher will respect the decision. The information collected would be treated with confidentiality and anonymity. Research ethics will be guided by UKZN Research Ethics Policy and Code of Conduct for Research. The Supervisor for this research is Doctor J. Naidoo (+2770312601127). My cell number is +263 0772 620 977.

....
Name of researcher Signature Date

1

CONSENT AND AGREEMENT

I ..... hereby allow my child to participate in the research study mentioned above. I understand that my child's 'participation shall be purely according to my wish as a parent/guardian of the child. Furthermore, I understand that the study shall not result in any benefit to me personally or to my child but seeks to broaden the understanding of the teaching of critical thinking skills with young learners.

....

Signature of parent/guardian Date

Appendix G: Ethical Clearance Letter

UNIVERSITY OF KWAZULU-NATAL
INYUVESI YAKWAZULU-NATALI

15 March 2016

Mrs Makonye Leah 213574343
School of Education
Edgewood Campus

Dear Mrs Leah

Protocol reference number: HSS/1530/015D
Project Title: Exploring the teaching of critical thinking skills in mathematical literacy with young children: A case study of five schools within the Zaka District

Full Approval – Expedited Application

In response to your application received 19 October 2015, the Humanities & Social Sciences Research Ethics Committee has considered the abovementioned application and the protocol has been granted **FULL APPROVAL.**

Any alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed Consent Form, Title of the Project, Location of the Study, Research Approach and Methods must be reviewed and approved through the amendment /modification prior to its implementation. In case you have further queries, please quote the above reference number.

PLEASE NOTE: Research data should be securely stored in the discipline/department for a period of 5 years.

The ethical clearance certificate is only valid for a period of 3 years from the date of issue. Thereafter Recertification must be applied for on an annual basis.

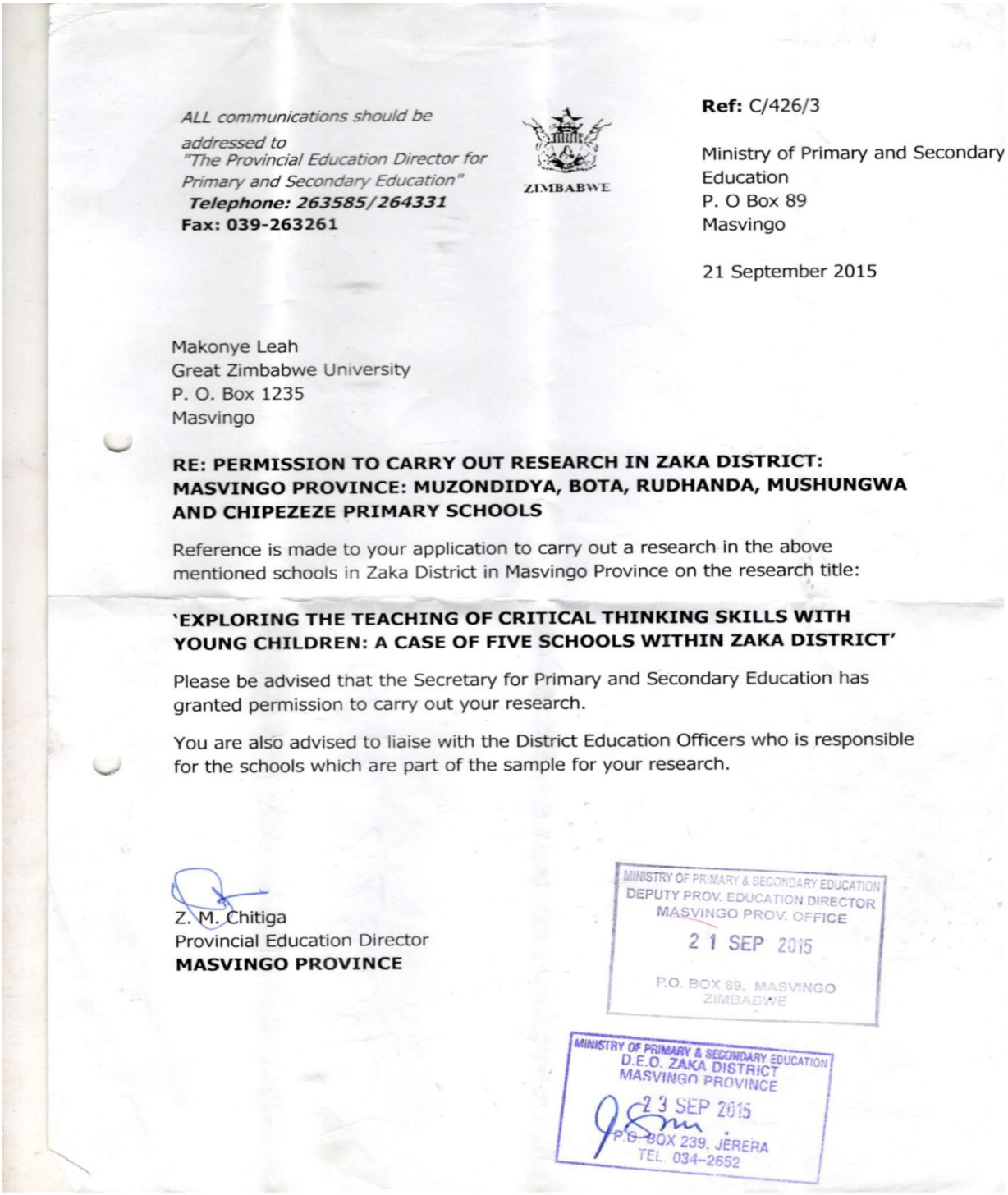
I take this opportunity of wishing you everything of the best with your study.

Yours faithfully

.....

Dr Shenuka Singh (Chair)
Humanitities & Social Scinces Research Ethics Committee

Appendix H:Ministry of Primary and Secondary Education Letter of Permission to Carry Out Research in Zaka District



ALL communications should be addressed to
"The Provincial Education Director for Primary and Secondary Education"
Telephone: 263585/264331
Fax: 039-263261

ZIMBABWE

Ref: C/426/3

Ministry of Primary and Secondary Education
P. O Box 89
Masvingo

21 September 2015

Makonye Leah
Great Zimbabwe University
P. O. Box 1235
Masvingo

RE: PERMISSION TO CARRY OUT RESEARCH IN ZAKA DISTRICT: MASVINGO PROVINCE: MUZONDIDYA, BOTA, RUDHANDA, MUSHUNGWA AND CHIPEZEZE PRIMARY SCHOOLS

Reference is made to your application to carry out a research in the above mentioned schools in Zaka District in Masvingo Province on the research title:

'EXPLORING THE TEACHING OF CRITICAL THINKING SKILLS WITH YOUNG CHILDREN: A CASE OF FIVE SCHOOLS WITHIN ZAKA DISTRICT'

Please be advised that the Secretary for Primary and Secondary Education has granted permission to carry out your research.

You are also advised to liaise with the District Education Officers who is responsible for the schools which are part of the sample for your research.

Z. M. Chitiga
Provincial Education Director
MASVINGO PROVINCE

MINISTRY OF PRIMARY & SECONDARY EDUCATION
DEPUTY PROV. EDUCATION DIRECTOR
MASVINGO PROV. OFFICE
21 SEP 2015
P.O. BOX 89, MASVINGO
ZIMBABWE

MINISTRY OF PRIMARY & SECONDARY EDUCATION
D.E.O. ZAKA DISTRICT
MASVINGO PROVINCE
23 SEP 2015
P.O. BOX 239, JERERA
TEL. 034-2652

Appendix I: Letter from the Editor

HUMAN RESOURCES
RESEARCH CENTRE

Human Resources Research Centre
P.O. Box MP167, Mount Pleasant, Harare, Zimbabwe
(263) 772241953
E-mail: gamatw@gmail.com

FACULTY OF EDUCATION UNIVERSITY OF ZIMBABWE

5 November 2018

To whom it may concern

This serves to certify that the PhD document titled: **Exploring the Teaching of Critical Thinking Skills to Learners to Promote Mathematical Literacy: A Case of Five Schools in the Zaka District of Zimbabwe** by **Leah Makonye** (Student No. **213574343**), was edited by an experienced editor/proof-reader. I have edited the document and advised the author to effect various changes including the mechanics of language, formatting of text and referencing style.

I am of the view that the quality of the document is of generally accepted academic standards.

Thank you.

Thomas W. Gama
(Editor)

Appendix J: Turnitini/ Ephorus Certificate

turnitin | ephorus

Document title PhD Thesis Makonye L CLEAN.docx
Submit date Mon 05 Nov 2018 10:02:57 PM CET

3%

1% http://ojs.academypublisher.com/index.php/tpls/article/download/tpls0303503507/6600
1% Developing Critical Thinking in English Class: Culture-based Knowledge and Skills
1% http://home.lagrange.edu/educate/Advanced%20Programs/M.Ed.%20Defense%20Assessment/Zachary%20final%.
1% http://www.pearsonassessments.com/hai/images/tmrs/criticalthinkingreviewfinal.pdf
1% Thinking Skills to Thinking Schools: Ways to Develop Children's Thinking and Learning
1% http://www.ejbrm.com/issue/download.html?idIssue=30
1% http://en.wikipedia.org/w/index.php?title=Constructivism+%28philosophy+of+education%29&oldid=840191231
1% Equivalence in measuring mathematical competence in PISA 2012 and in the National Assessment 2012
1% http://www.science.gov/topicpages/c/critical+thinking+based.html
1% http://www.oecd.org/education/48111145.pdf
1% http://dspace.library.uu.nl/bitstream/handle/1874/323912/8.pdf?sequence=1
1% http://homepages.lboro.ac.uk/~mafkd/ISTE_2012_Proceedings.pdf
1% http://reforma.fen.uchile.cl/Papers/Teaching%20Critical%20Thinking%20Skills%20and%20problem%20solving%20..
1% Critical thinking: Essence for teaching mathematics and mathematics problem solving skills
1% Learner-controlled scaffolding linked to open-ended problems in a digital learning environment
1% Social constructivism in the classroom
1% 'I didn't used to have much friends': exploring the friendship concepts and capabilities of a boy with autism and seve...
1% Found at: UOZ University of Zimbabwe (DOC PROJECT.pdf, 11/13/2015)
1% Found at: UOZ University of Zimbabwe (final masters thesis compiled.docx, 11/29/2013)
1% Found at: UOZ University of Zimbabwe (GOBA WITNESS TATENDA R013239F.doc, 12/17/2012)
1% chapter 4 Promoting Critical Thinking in the Modern Learning Environments
1% Supporting Doctoral Students through the Personalisation of a Graduate Virtual Research Environment
1% The Differential Effect of Indirect Instruction in the Teaching of Sport Skills on Critical Thinking
1% Found at: UOZ University of Zimbabwe (tonderai mangwende, r164495x, Hand-in code - mangwende - r164495x, ...

EXPLORING THE TEACHING OF CRITICAL THINKING SKILLS TO LEARNERS TO PROMOTE MATHEMATICAL LITERACY: A CASE OF FIVE SCHOOLS IN ZAKA DISTRICT OF ZIMBABWE

by

LEAH MAKONYE 213574343

Submitted in accordance with the requirements for the degree of

DOCTOR OF EDUCATION

In the subject

MATHEMATICS EDUCATION

at the

UNIVERSITY OF KWAZULU-NATAL

SUPERVISOR: DR JAYALUXMI NAIDOO