Integrating Mathematical Concepts and Processes into Children's Learning Experiences at Kindergarten 2 Level: An Action Research Project

By

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Abstract

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With the introduction of the Learning Outcomes Framework (LOF) in September 2018, the Maltese educational system experienced a reform in the approach to teaching and learning, namely, a shift from a content-based to an outcome-based curriculum. To implement the LOF in the Early Years, the emergent curriculum approach was introduced. This requires educators of children aged 3-7 years to develop learning programmes in response to children's needs and interests. Additionally, since subjects are not identified for the Early Years, learning areas, including Mathematics, are to be addressed through project work. In the light of all this, and in my role as an Assistant Head of School, I wished to carry out a study in my own school to support educators to implement the change. Consequently, this study focuses on how I worked collaboratively with four kindergarten educators (KGEs) to support them to implement the change in their practice. A qualitative research methodology was employed through an action research approach. Data was gathered through focus group discussions and stimulated recall interviews with the KGEs, classroom observations and interviews with the Assistant Head of School, from which a number of themes were elicited. From the study it emerged that the collaboration helped the educators to reflect on their practice which, in turn, led them to develop professionally. Through scaffolding practices, I assisted the educators to create learning opportunities through which children's mathematical learning was enhanced. As a result, a number of suggestions for professional development trainers, schools, and classroom practitioners are presented, highlighting the importance of investing in educators' professional growth to enhance children's learning of Mathematics.

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Keywords: Mathematics, Early Years, Emergent Curriculum, Kindergarten, Collaboration, Professional Growth

To

all Teachers, Kindergarten Educators and Learning Support Educators

who, with their commitment and love for teaching,

touch the lives of many children.

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Chapter 1: Introduction

1.1 Introduction

In 2012, the Maltese education authorities launched a new curriculum, namely, the *National Curriculum Framework* (NCF) (Ministry of Education and Employment, (MEDE), 2012). The NCF proposed a shift from a prescriptive curriculum to one focused on flexible learning programmes which address the needs of every learner. It promoted an approach to learning based on the co-construction of knowledge between the teacher and the learner, rather than simply content acquisition (MEDE, 2012). So as to ensure a seamless transition through the learner's compulsory educational journey, the curriculum identified three educational cycles. These are: *Early Years* (Kindergarten 1 and 2, Primary Years 1 and 2, ages 3-7 years), *Junior Years* (Primary Years 3-6, ages 8-11 years) and *Secondary Years* (Years 7-11, ages 12-16 years). This was the first time that the Early Years were acknowledged as a separate cycle from the Primary school years (Sollars, 2013).

For each educational cycle, the NCF put forward general learning outcomes which were then developed into a Learning Outcomes Framework (LOF) (Ministry of Education and Employment, (MEDE), 2015). The LOF proposes ten levels of attainment, of which Levels 1-4, target the Early Years (ages 0-7). During the Early Years cycle "the emphasis is on the development of skills, knowledge, competencies, values and positive dispositions towards learning" (MEDE, 2012, p. 33) and consequently no subject learning areas are identified.

The approach to teaching and learning in the Early Years as set forth by the NCF, and subsequently the LOF, is based on a negotiated curriculum between the teacher and the

children. The curriculum is 'negotiated' as it is derived from the children's interests and framed by the teacher (Forman & Fyfe, 1998). This approach to learning in the Early Years cycle "implied changes to pedagogical practices which would require practitioners to move away from spoon-feeding, handholding and planning decontextualized activities to address short-term objectives" (Sollars, 2018, p. 345). Indeed, to implement the NCF and the learning outcomes as recommended in the LOF, in July 2018, the Education Officers in charge of the Early Years, introduced a new approach to teaching and learning in the Early Years, namely, an *Emergent Curriculum Approach*.

The emergent curriculum approach gives the flexibility to educators to create a curriculum based on the interests and needs of the children under their care (Stacey, 2009). It is an 'emergent' curriculum as it is not defined at the outset, but it is developed in response to the children's thoughts and ideas (Wien, 2008). Children are curious, creative and ambitious and they are viewed as active protagonists in their learning (Malaguzzi, 1994). By listening to, and observing the children, the educator identifies the children's interests, questions and current level of understanding, and can thus plan a curriculum to cater for their needs (Hewett, 2001). The educator chooses a topic that the children are interested in and develops learning opportunities within a project approach. In this way, educators act as facilitators, who provide children with opportunities to help them advance in their learning to reach their potential (Hewett, 2001). This is consistent with Vygotsky's (1978) view that children need *the assistance of others* to progress in their learning and development and thus, move forward in what he termed the Zone of Proximal Development (ZPD).

Implementing an emergent curriculum approach means that educators need to transform their practice. This is because prior to the development of the LOF, educators in charge of kindergarten classes in Malta followed a set of guidelines which included the learning objectives and suggestions for the implementation of the curriculum (Attard, 2002). Moreover, educators addressed subjects such as Mathematics and Science through specific teacher-directed activities. As indicated above, the LOF does not identify specific subject learning areas for the Early Years cycle. However, with regards to Mathematics a number of learning outcomes target mathematical content such as:

- *I understand basic concepts of shapes, numbers and patterns.*
- *I can sort, match, compare and contrast, classify and seriate a wide variety of objects during play* (MEDE, 2015, p. 13 & p. 14 respectively).

There are also a number of learning outcomes which target processes that are relevant to mathematics, for example:

- *I can predict and think logically, make assumptions, hypothesise, ask questions and reply to open-ended questions.*
- *I can make connections between experiences, concepts and processes* (MEDE, 2015, p. 14).

Thus, when employing an emergent curriculum approach, educators need to create learning opportunities from which they can help children connect their experiences to mathematics (Wien, 2008). Educators need to observe and listen to the children's spontaneous talk and actions and seize the opportunity to address mathematics related learning outcomes through prompts and questions. As Sampson and McLean (2021) explain, when applying an emergent curriculum approach, educators need to "think on their feet […] to support and expand [the

children's] ideas and interests" (p. 38). However, these authors argue that applying such an approach may prove to be challenging for educators. According to Manesi and Betsi (2013) to counter the challenges they face, educators need to be supported by significant others who can assist them to reflect and evaluate their practice to grow professionally.

1.2 Aims of the Study

The emergent curriculum approach is of particular interest to me as I work as an Assistant Head of School in a state primary school and I am specifically in charge of the early years classes. The emergent curriculum approach was introduced in Kindergarten 1 (KGI) classes during scholastic year 2018/2019 and subsequently in Kindergarten 2 (KGII) the following scholastic year. From what I had observed during classroom observations, and from informal discussions with the kindergarten educators (KGEs), I felt that they were still unsure about how to implement the change to their practice. Furthermore, mathematics was still being carried out separately to projects, with activities being pre-set by the educators. Although children may have enjoyed the mathematics activities, they were most likely limited in their actions and choices.

Furthermore, prior to my deployment as an Assistant Head of School, I served the role of a Mathematics support teacher, where I provided guidance and support to Primary school teachers with regard to the teaching and learning of Mathematics. Therefore the teaching of mathematics is of particular concern to me. Following Aubrey et al. (2006), I have always believed that it is important that during the Early Years children have a good start in mathematical understanding as a foundation for school mathematics. Furthermore, as Montague-Smith et al. (2017) assert, young children should not learn mathematics in

isolation, as an academic subject, but experience it in connection to their everyday life. Thus, educators need to create learning opportunities that are integrated into an ongoing project where mathematics is embedded in a number of activities including, play, cooking, singing and storytelling.

My position as an Assistant Head of school, together with my interest in mathematics and the emergent curriculum approach, led me to embark on this research. As a member of the School Leadership Team (SLT), I felt that I could be of assistance to the KGEs in my school, to help them implement the change in their practice and thus plan learning opportunities as part of their projects wherein mathematical concepts and processes could be addressed. I wished to work in collaboration with the KGEs to develop a plan and support them to implement it in the classroom. I chose a collaborative approach because, as indicated by Hallinger and Heck (2010), collaboration between school leaders and teachers is a significant factor that helps teachers to transform their practice. Furthermore, I wished to investigate if, and how, the plan helped to develop the children's mathematical learning. Thus, the following research questions emerged:

- *How can a member of the School Leadership Team work collaboratively with kindergarten educators to support them in their professional growth?*
- *How can this collaboration help kindergarten educators to devise a plan to incorporate the mathematical concepts and processes mentioned, or implied, in the Learning Outcomes Framework document for the Early Years (Levels 1-3) into the project approach?*
- *How can this collaboration support the implementation of the plan in the classroom, to provide children with opportunities to learn mathematics?*

1.3 Methodology Used

The study was conducted in my school, with four KGII educators, who were each in charge of 14, four- to five-year-old boys and girls. I adopted a qualitative approach to the study since I wanted to obtain detailed information directly from the participants and in their own context (Creswell & Poth, 2018). Since my aim was to collaborate with the KGEs to plan learning opportunities and implement them in the classroom, I employed a collaborative action research approach. This allowed the participants to engage in an action-reflection process which led them to transform their practice (McNiff, 2016). The data was gathered through focus group discussions, stimulated recall interviews and classroom observations. I also conducted two semi-structured interviews with the Head of School to gain insight into her thoughts about the study and its relevance to the school. The data was analysed and discussed by means of a thematic approach.

1.4 Structure of the Study

This dissertation is presented in six chapters. This first chapter is an introduction to the research, where a brief account of the purpose of the study, the research questions and the methodology are presented. In Chapter 2 the reader is introduced to key 20th century developments in Maltese education and how these developments led to the provision of kindergarten education. In addition, developments in the curriculum for the early years are discussed with emphasis on literature pertaining to the emergent curriculum approach. Furthermore, this chapter explores early childhood mathematics, mathematics content and process standards and the significance of play for childhood development and mathematics learning. In Chapter 3, the theoretical framework which guides this research study is presented.

Chapter 4 deals with the research design of the study, outlining the philosophical position of the researcher which informed the methodology applied and methods used to collect the data. Reference is also made to ethical considerations. The analysis and discussion of the findings through a thematic approach are presented in Chapter 5. In the final concluding chapter, a summary of the main findings is given, showing how the study addressed the research questions. This chapter will also offer implications for training, recommendations for schools and for the KGEs, together with the limitations of the study.

1.5 Conclusion

"Collaborative research, […], has as its objective to create in schools a culture of analysis of the practices, allowing teachers, […], to transform their actions and institutional practices" (Pimenta, 2007, p. 78). I hope that this collaborative action research process will help the KGEs to continue to reflect on their practice and lead them to adopt the recommended pedagogical practices, thus enhancing their professional growth and providing learning opportunities through which children experience meaningful mathematics. I also hope that the findings from this research will be useful for school practitioners in a leadership role, in that they gain insight into the benefits of working in collaboration with members of their teaching staff to enhance their professional development.

Chapter 2: Literature Review

2.1 Key 20th Century Developments in Maltese Education

The Maltese Education Act stipulates that education is compulsory for children between the ages of 5 and 15 years. However, this was not always the case. According to Zammit-Mangion (1988), children's compulsory attendance to school for children between the ages of 5-12 was enforced in 1924 with the introduction of the Compulsory Attendance Act. However, Zammit Mangion (1956) states that only children who were registered for attendance were obliged to attend school, which resulted in having thousands of children unaccounted for. Moreover, the aftermath of the Second World War brought widespread poverty to the Maltese islands and many children had to help their parents to earn an income to the detriment of their education (Zammit-Mangion, 1988). This resulted in a high rate of illiteracy and generated concern on the general low level of education (Zammit-Mangion, 1988). To counteract this phenomenon, decisive measures were taken and in 1946 the "Compulsory Education Ordinance made primary school education compulsory for all Maltese children between the ages of 5 and 14" (Bezzina, 2015, p. 524). Access to state secondary education was only by means of an 11+ examination and those students who failed the exam or opted not to sit for it, had to remain in Primary school until the school leaving age of 14 (Bonnici & Soler, 2002).

In May 1969, the Sixth Conference of European Ministers of Education, which was held in France, discussed amongst other issues *the system of non-selective comprehensive education at secondary level* (Council of Europe, 1969, para.2). During this conference a number of recommendations were made, one of which was that of permitting all students, irrelevant of their abilities or social background, to have access to secondary education. Following this

recommendation, secondary education for all in Malta was introduced in 1970 (Bonnici & Soler, 2002).

2.2 A History of Kindergarten Provision in Malta

During the 19th century, Malta was under British rule and any developments with regard to the local public education were decided by the British government. In 1850 the state of education on the island was very poor and this led the British governor to appoint Canon Pullicino as Director of Education to manage and reform elementary schools (Zammit Mangion, 1956). Canon Pullicino's main aim was to pull children off the streets and offer them quality education. He made a number of recommendations, one of which was to set up infant schools for children between two to six years of age (Sollars, 2018). However this recommendation was shelved due to political resistance and, consequently, provision for the two to six cohort did not materialise (Spiteri & Galea, 1994). The ensuing years did not see any improvement in state elementary education in Malta and a report issued by Patrick Joseph Keenan in 1879 criticized the programmes of instruction and the unsuitable school buildings wherein classrooms were small, badly ventilated and unsuitable for children (Camilleri, 1978). Keenan proposed a number of changes to ameliorate education in Malta and, as a result of this, the Government terminated Canon Pullicino's appointment and appointed Sigismondo Savona as Director of Public Education in 1880 (Spiteri & Galea, 1994). Savona tried to follow Keenan's recommendations but he only managed to introduced a few changes (Camilleri, 1978), none of which provided services for children under six years of age. It was only in 1920 that early education for children was mentioned, by Dr. Laferla, the then Director of Elementary Schools. In a review he made of the educational system, he pointed out a number

of deficiencies, one of them being the late age that children were admitted to school, that is at six years of age (Abela, 2017).

However, education, including what is now known as the kindergarten sector, was provided by private individuals and Religious Orders. In 1845, the Sisters of St Joseph of the Apparition were the first nuns who opened the first school for girls between four to five years (Sollars, 2018). They were followed by other Religious Orders, such as the Fransiscan Order of the Sacred Heart in 1880 and the Order of St Dominic in 1881, who offered their services to children from three years of age. The contribution of these Religious orders and of private individuals made a significant contribution to the Maltese education system right up to the 1970s (Spiteri & Galea, 1994).

In the early 1970s, the setting up of a number of factories in Malta provided an opportunity for more women to join the workforce. This phenomenon resulted in a need to set up kindergarten services for children under the compulsory school age of five, so that mothers had a safe place to leave their children whilst they went to work (Spiteri & Galea, 1994). Since until then, the services offered at kindergarten level were predominantly run by Catholic Religious Orders against a fee (Zammit Mangion, 2000) in 1975, the Maltese government introduced the provision of free kindergarten education. This service was established inside every primary school, in Malta, for children between the ages of three years nine months to five years (Sollars, 2018). The general aims behind this provision were:

- *Giving children the opportunity to socialise and develop their abilities under guidance;*

- *Giving children from homes lacking suitable educational opportunities, the chance to develop and catch up with the others;*
- *Providing remote preparation for entry into primary schools;*
- *Providing relief for working mothers.* (Sollars et al., 2006, p. 24)

This was a supplementary service rather than an integral part of the educational system (Sollars, 2018) since, although the kindergarten centres were located inside the primary schools, the instruction of these classes was not carried out by teachers, but by 'Kindergarten Assistants'. The first Kindergarten Assistants were a group of unmarried females who took a six-week training course, in the summer of 1976 (Spiteri & Galea, 1994). The aim behind the training was to outline the role of the Kindergarten Assistants and equip them with the necessary skills to cater for the children under their care. This training was further extended to a three-month course, which covered topics ranging from record keeping to the holistic development of the child.

Kindergarten centres were very popular from the start (Mangion Zammit, 2000) and statistics show that 2477 children attended these classes in the first year of opening (Spiteri & Galea, 1994). As from 1988 this service was further extended to three year old children (Sollars, 2018), so that the kindergarten sector had two levels: kindergarten 1 (KGI) and kindergarten 2 (KGII).

2.3 The Curriculum in the Early Years

Notwithstanding the popularity of the kindergarten provision, and hence the number of children making use of this service, there was no formal curriculum in place. The first attempt at formalising a kindergarten curriculum and recognising kindergarten education as part of

the children's educational process occurred in 1999 with the launching of the *National Minimum Curriculum* (NMC) (Sollars, 2007). This document tapped on the notion of empowering schools to develop their own curriculum within the parameters of the principles and aims of the NMC. The underlying principles in the NMC were those of putting the child at the centre of their learning experience and creating a stimulating learning environment where the child had the opportunity to reach their full potential (Galea, 1999). The specific aims proposed were grouped into three levels namely, kindergarten, primary and secondary level. At kindergarten level, the main focus was on five areas of the child's development: *intellectual*, *emotional*, *physical*, *moral*, *sense of aesthetics and creativity* and *religious development* (Ministry of Education, 1999).

Sollars (2013) reports that following the publication of the NMC, the Education Officer in charge of the kindergarten level issued a detailed document with guidelines and recommendations for the implementation of the curriculum at kindergarten level. For each area of development a number of learning objectives were outlined. For example, for the aspect *Intellectual Development – Mathematics*, two of the learning objectives were:

- *Says number names in order up to 10, forwards and backwards.*
- *Uses developing mathematical ideas and methods to solve practical problems related to Number, Shape and Space* (Attard, 2002, p. 22 & p. 27 respectively).

In addition to the guidelines document, another document called Record of Development and Progress (RDP) was made available to Kindergarten Assistants. This document was in the form of a checklist and Kindergarten Assistants were expected to assess and record each child's progress, an approach which "suggeste[d] that children are all developing in the same way: in

a linear fashion and expected to achieve the same objectives" (Sollars, 2013, p. 51). However, according to the Organisation for Economic Co-operation Development (OECD) (2004), quality early childhood programmes should be developed in such a way as to "simultaneously meet each child and his or her experiences, while directing the child towards the objectives of learning" (p. 27).

Indeed, to "increase the relevance of the teaching process to meet the individual needs of the learners" (MEDE, 2012, p. 6), in 2012, the Maltese Education authorities launched a new curriculum framework, *A National Curriculum Framework for All* (NCF) (MEDE, 2012). The NCF promotes the principle of equity to ensure that all students have access to the same opportunities and recognises that each student is unique and teachers need to respond in different ways to each student. This document taps on the notion that every child is entitled to obtain the knowledge, abilities, dispositions and values required to become an active citizen of their community and the world (Cristina, 2012). The NCF was constructed on a number of key principles, providing essential guidelines to all stakeholders within the educational system. These principles advocated an improvement in the quality of education by shifting from a prescriptive curriculum to a curriculum which caters for the needs of all learners and, as a result, raising students' achievements.

The NCF established three cycles in the education system, namely, *Early Years (*Kindergarten 1 and 2, Primary Years 1 and 2, ages 3-7 years), Junior Years (Primary Years 3 – 6, ages 8-11 years) and Secondary Years (Years 7 – 11, ages 12-16 years). This was the first time that the Kindergarten sector and Years 1 and 2 were considered together as a cycle separate from the primary and the secondary years (Sollars, 2013). The main aims behind this integration in the

Early Years was to buttress the transition between Kindergarten and Years 1 and 2 and to provide a seamless continuation in the child's development at their pace of learning (MEDE, 2012).

For the Early Years cycle, the NCF put forward a whole new approach to education by promoting learning which is relevant to the learners' real-life situations within a stimulating environment, thus challenging the minds of the learners (MEDE, 2012). This curriculum also promoted child-initiated learning opportunities and hands on activities and encouraged a positive attitude towards the learners' diverse learning dispositions (MEDE, 2015). Learning dispositions incorporate the inclination, willingness and readiness to learn, enabling children to construct learner identities which support lifelong learning (Ministry of Education, New Zealand, 2017). It is thus fundamental that Early Years programmes foster an environment where children are actively involved in their own learning journey, leading to the acquisition of social, communicative and intellectual competencies (MEDE, 2012). To this end, the NCF presented five broad learning outcomes for the Early Years cycle which were to serve as the basis of learning programmes in this cycle. These are:

- Children who develop a strong sense of identity.
- Children who have a positive self-image.
- Children who are socially adept.
- Children who are effective communicators.
- Children who nurture positive attitudes towards learning and become engaged and confident learners (MEDE, 2012, p. 21-23).

Furthermore, the NCF recommended that the broad learning outcomes, which were proposed for each cycle in the educational system, were to be translated into a Learning Outcomes Framework (LOF). The aim of the LOF is to serve as a national benchmark, providing all stakeholders in the education system with an understanding of what knowledge, skills and attitudes students should achieve by the end of compulsory education (MEDE, 2015). The LOF is also intended to give educators the opportunity, to create themselves, programmes that address the learning outcomes without being constrained by *centrally-imposed knowledge-centric syllabi* (Attard Tonna & Buġeja, 2016). In 2015, the LOF was launched, presenting ten levels of attainment. The first four levels of attainment target the Early Years cycle which include: Levels 1-3 - childcare and kindergarten (ages 0-5 years) and Level 4 - Primary years 1 and 2 (ages 6-7 years). Levels 5 and 6 target the Junior Years cycle (ages 8-11 years) and levels 7 to 10 the Secondary Years cycle (ages 12-16 years). Each of the ten levels of attainment was developed into a number of learning outcomes. Battersby (1999) sustains that learning outcomes are an approach to teaching and learning rather than a formula to be applied. The educators' focus should be on what the students need to know and what they can make use of to enhance their lives and to contribute more effectively to society (Battersby, 1999). By implementing this approach, learning becomes a process (French, 2007), whereby the educator's focus is on what the student will be able to do (Battersby, 1999) rather than what they has to deliver to the students.

The learning outcomes presented in the LOF form the basis of the curriculum which is presently being implemented in our schools, serving as an overall guide for the educators' pedagogy. The Early Years curriculum, as presented in this document, views learning as a process and each learning outcome places the child at the centre of their learning experience.

Educators should endeavour to create meaningful experiences and learning opportunities, in a stimulating environment conducive to learning (Attard Tonna & Buġeja, 2016). The learning that takes place should be derived from the children's interests, strengths, needs, prior knowledge and experiences. Each learning outcome proposed is articulated in a number of *'I'* statements such as:

- *I use symbols in play to represent ideas.*
- *I understand that spoken language can be written down.*
- *I can make a variety of marks and scribbles* (MEDE, 2015, p. 13).

These statements allocate empowerment of the learning experience to the learner and thus, children, under the educators' guidance, become active agents in their learning. This in turn will enhance the children's social, communicative and intellectual competencies, fostering personal well-being and positive learning dispositions as outlined in the NCF (MEDE, 2012).

The LOF started being phased into the Maltese education system during scholastic year 2018/2019, with KGI being the first to implement it in the Early Years cycle (Eurydice, 2020). This change required a shift in the approach to teaching in the Early Years from a pedagogy based on prescriptive planning to one which is "student-centred and inquiry based" (MEDE, 2012, p. 63). To this end, in July 2018, the Education authorities introduced a new pedagogical approach for the Early Years cycle based on an emergent curriculum approach. It was also recommended that the curriculum is developed through project work.

2.4 The Emergent Curriculum Approach

Sampson and McLean (2021) define an emergent curriculum as "an open-ended yet intentional way of teaching" (p. 34) that focuses on the process of learning rather than the end product. The emergent curriculum is generated from "a dynamic process of inquiry that develops with common interests shared by the adults and children alike" (Palmer, 2008, p. 26). Thus, educators adopt collaborative pedagogical practices (Nxumalo et al., 2018) and the learning that takes place is negotiated between the child and the educator. The educator acts as a facilitator as they uncovers the children's beliefs and interests and reframes them into outcomes for the curriculum (Forman & Fyfe, 1998). In contrast to a prescriptive curriculum, where educators plan ahead what the children should be learning, in an emergent curriculum approach the children become active agents in their learning journey (Ambery & Steinbrunner, 2016). Malaguzzi (1998) sustains that educators should follow the children not the plan, as the children create an environment that lends itself to opportunities for them to inquire, discover and wonder. Consequently, the educator's work is to listen to the children's talk, observe their actions, representations and expressions and to document all this to inform the curriculum planning (Rinaldi, 1998).

2.4.1 Listening to children and observing their actions

Rinaldi (1998) defines listening as a "means of giving value to others, being open to them and [to] what they have to say" (p. 120). The process of listening is not a passive act but an active one which involves a means of communicating by "hearing, interpreting and constructing meanings" (Clark, 2005, p. 491). Listening informs educators of the children's interests and current level of knowledge and they can thus design a curriculum which leads children to construct new knowledge (Sampson & McLean, 2021).

According to Forman and Fyfe (1998) educators need to "listen with the third ear" (p. 249) to acquire a deeper understanding of what the children's words really imply. They highlight that only when educators fully understand what lies behind children's discourse that they can negotiate and scaffold their learning (Forman & Fyfe, 1998). By listening attentively to children, educators understand the development of their thinking and can help them move to the next level of learning (Wein, 2008). This is consistent with Vygotsky's (1978) theory of the Zone of Proximal Development which highlights the importance of *more knowledgeable others* to assist children to move forward in their learning and development.

Clark (2005) sustains that it is important that educators support children by listening to what they are trying to communicate both verbally and non-verbally through careful observation. According to Stacey (2009), listening to and observing children's actions puts educators in a better position to develop the curriculum as it informs them not only what the children are doing but *how* they are doing it. This is consistent with Malaguzzi's (2012) view who postulates that by listening to and observing children we try to understand the *hundred languages of children*. The philosophy behind Malguzzi's hundred languages of children implies that children explore the world around them, express themselves and learn in multiple ways including through drawing, talking, dancing and playing (Mphahlele, 2019). This shifts the focus of the educator from that of educator to educator-researcher, as through the process of listening and observing the children's reactions and responses, the educator gathers knowledge about the children's interests, understandings and misunderstandings and subsequently uses that knowledge to plan the curriculum (Malaguzzi, 1994; Edwards, 1998; Tijnagel-Schoenaker, 2018). However, Rinaldi (1998) sustains that educators need to "leave

interpretable traces" (p. 120) of the knowledge gathered through listening and observation by using documentation.

2.4.2 Documentation

Forman and Fyfe (1998) describe documentation as "any activity that renders a performance record with sufficient detail to help others understand the behaviour recorded" (p. 241). In an emergent curriculum approach, documenting children's work is essential as it can be a means for educators to share children's experiences with the children themselves, parents and other educators (Stacey, 2009). Educators can present documentation in many forms including photographs, audio or video recordings, handwritten notes and drawings (Rintakorpi, 2016). Edwards and Gandini (1998) sustain that through documentation children's learning is made visible, thus making it possible for educators to analyse and reflect on children's activity, both on their own and with their colleagues. The process of reflection helps educators to develop their pedagogical practices, and to generate hypotheses and predictions for future curriculum planning (Rinaldi, 2005). Thus, documentation can be viewed as a tool that helps educators to become critical thinkers about the impact and purpose of their work with children (Fleet et al., 2011). Katz (1998) sustains that besides being a tool for teacher reflection, documentation can also serve as a reflective tool for children. When, through documentation, children discuss what they and their peers have done, they "revisit their own and others' feelings, perceptions, observations, and reflections, and then reconstruct and reinterpret them in deeper ways" (Edwards, 1998, p. 185). This process helps children to "become even more curious, interested, and confident as they contemplate the meaning of what they have achieved" (Malaguzzi, 1998, p. 70).

Another benefit of documentation outlined by Katz (1998) is its impact on parents. Katz acknowledges that documentation allows parents to gain insight on the children's learning experiences in the classroom. As Rinaldi (2005) states "[t]hrough the documentation, parents can have a direct look, with real and tangible examples, at the enormous wealth of their children's potential which is made visible" (p. 101). This is in line with one of the tenets of the NCF which emphasises the need for parents to be part of their children's learning journey (MEDE, 2012).

Documentation can also be used as a form of assessment, helping the educator to focus on what the child can do on his own or with assistance from others (Forman & Fyfe, 1998). As outlined by Rinaldi (2005), documentation helps educators to become enriched in their knowledge about the children's achievements and can take informed decisions on future planning to enhance their development. In addition, Hostyn et al. (2018) emphasise that documentation gives the educators a broader picture of the children's level of learning and development than any other kind of tool such as tests or checklists.

Katz (1998) states that children, educators and parents can reap the benefits of documentation only if it is *worthy* of reflection and discussion. Katz (1998) explains that for documentation to be worthwhile it needs to show children "engaged in interesting projects and other activities" (p. 40). As highlighted by Clark (2000), project work offers children the opportunities to investigate, solve problems and present findings which may increase their motivation and disposition to learn.

2.4.3 The project approach

Katz and Chard (2012) describe a project as "an extended in-depth investigation of a topic, ideally one worthy of the children's attention, time, and energy" (p. 303). Project work can be a way for educators to develop the emergent curriculum as it "promotes children's intellectual development by engaging their minds in observation and investigation of selected aspects of their experience and environment" (Katz & Chard, 2000, p. 2). This is in line with the NCF's (MEDE, 2012) recommendation that Early Years programmes should be built on "inquiry-based activities and independent explorations" which "challenge the minds of learners" (p. 49). Indeed, the processes of a project help children to:

(1) develop their own questions about the topic under investigation,

(2) make predictions about possible answers,

(3) think of ways to test their hypotheses,

(4) negotiate with the teacher various ways they might represent their findings, and

(5) take time to solve their own problems through trial and error (Clark, 2006, p. 1).

The processes are realised through a number of learning opportunities created by the educator which include a mixture of child-initiated and teacher-led activities (Helm & Katz, 2001).

Child-initiated activities provide children with opportunities to "choose their own pursuits and learning explorations, take ownership of the planned activities to adapt them to their own purposes, and incorporate their own experiences into learning opportunities […]" (Kinos et al., 2016, p. 345). The role of the educator during child-initiated activities is that of facilitator, who provides feedback, through questions and prompts, to scaffold children's learning (Vaisarova & Reynolds, 2022). In this way, child-initiated pedagogy allows for the co-

construction of knowledge between the children and the educator (Kinos et al., 2016). In contrast, during teacher-led activities, the educator structures learning opportunities with a specific objective in mind and children follow the educator's lead (Vaisarova & Reynolds, 2022). Knowledge is typically transmitted from the educator to the children and the emphasis is more on content acquisition rather than on the children's interests and needs (Lerkkanen et al., 2016). Helm and Katz (2001) argue that while child-initiated investigations may help children to construct new knowledge, there are *academic goals* that have to be developed through teacher-led learning opportunities. As such, the educator should create a *balance* of child-initiated and teacher-led opportunities (MEDE, 2012) which support the children's learning dispositions while at the same time achieving curriculum learning outcomes (Helm & Katz, 2001).

Katz and Chard (1992) propose three phases in the project approach which are essential to the successful implementation of a project. These phases are:

- Phase 1 - Beginning the Project
- Phase 2 - Developing the Project
- Phase 3 – Concluding the Project.

These will be briefly explained below.

<u>Phase 1 - Beginning the project</u>

The first step is to select a topic. The task of the educator at this stage is to identify any current or emerging interests that the children may have (Beneke et al., 2018). In an early years setting the educator may use the time during free play to observe the children and elicit a topic of interest (Sargent, 2011). The practice of listening and observing leads educators to

identify the children's interests, the reason behind their interest and where they stand in their current level of knowledge (Forman & Fyfe, 1998). However, Katz and Chard (2012) argue that having a large group of children in the classroom, with a number of possible interests, may present a difficulty for educators to choose a topic. Therefore, educators need to set criteria to determine which topics have the most potential for exploration and in-depth investigation (Beneke et al., 2018). Once the topic is identified the educator's role is to discuss the topic with the children, creating a topic web which depicts the children's ideas and knowledge of the topic and any curiosities and questions they may have (Chard, 1998).

Phase 2 – Developing the project

The web is a useful resource for educators as it can assist them to predict the possible outcomes of the topic and help them in planning strategies to enhance students' experiences (Helm & Katz, 2001). The educator draws on the questions and curiosities generated by the web to determine which learning opportunities can be created to enhance children's learning and development. Beneke et al. (2018) sustain that during this phase it is important that children develop their knowledge about the topic through real world experiences. Thus, learning opportunities can take the form of fieldwork experiences or inviting experts on the topic to the classroom (Katz & Chard, 2012). The educator may also set provocations by giving the children resources related to the topic and leave the children to investigate and wonder, while observing where their imagination is leading them (Sargent, 2011). The observations, together with documentation, can help the educators to be more informed on how to develop the ongoing project to further enhance the children's knowledge (Wein, 2008).

Phase 3 – Concluding the project

This is the stage where children share what they have experienced and learned from the project with others (Beneke et al., 2018). This can be done by displaying the documentation of the work for other classes and parents to see. The educator can also refer to the web created in Phase 1 together with any documentation gathered, to help children evaluate their own and others' work through discussion (Katz, 2010). According to Helm and Katz (2001) the final phase in the project approach helps children to consolidate what they have learnt during the project experience.

Sargent (2011) sustains that when educators include projects in the curriculum they enable children "to engage in imaginative and creative thought processes that lay the foundations for future independent learning" (p. 12). Furthermore, during project work children's learning dispositions are strengthened as they have the opportunity to apply knowledge and skills repeatedly within a meaningful context (Katz & Chard, 2012).

2.5 A Brief History of Early Childhood Mathematics Education

Interest in early childhood mathematics education in Europe can be traced back to the 17th century when John Amos Comenius published the book *School of Infancy* in 1631 (Elia et al., 2018). In his book, Comenius, talked about children's education from birth to six years (Saracho & Spodek, 2008). He proposed a mathematics curriculum based on the use of concrete objects as he believed that children learn by observing and manipulating objects (van den Heuvel-Panhuizen & Elia, 2014). Mathematics in early childhood was also given due importance by the English philosopher John Locke in his writing titled *Some Thoughts Concerning Education* in 1693 (McNulty, 2014). He asserted that mathematics helped children

to acquire reasoning skills and that it played an important role in children's educational programmes (McNulty, 2014). Another important development in young children's mathematics education was the establishment of the *Infant School* in Scotland, by Robert Owen in 1816 (Bradburn, 1966). As explained by van den Heuvel-Panhuizen and Elia (2014), the *Infant School* developed mathematics programmes with the aim of helping children understand mathematical operations using concrete objects.

In 1837, the teaching of mathematics in early childhood was influenced by Freidich Froebel, who founded the first kindergarten in Germany (Saracho & Spodek, 2008). Froebel's philosophy was to create a space for young children, outside their homes, where they had the opportunity to develop freely under the supervision of adults (Lascarides & Hinitz, 2000). He based his teaching programme on play activities, as he believed that play was instrumental to the children's development (Nutbrown & Clough, 2014). Froebel is known for creating what he called 'gifts', a set of geometric toys, such as blocks, for the children to play with (May, 2016). The toys were given to children in a prescribed order to help them understand mathematical content such as numbers, geometry and pattern (van den Heuvel-Panhuizen & Elia, 2014). Froebel's philosophy and methods were soon adopted by other countries in Europe and America (Saracho & Spodek, 2008).

A key individual who created mathematical teaching practices for young children was Maria Montessori (van den Heuvel-Panhuizen & Elia, 2014). She opened the first 'house for children' in 1906, promoting the teaching of reading, writing and arithmetic (Lascarides & Hinitz, 2000). She based her teachings on the use of sensory materials as she believed that children acquired knowledge about the world through their senses (van den Heuvel-Panhuizen & Elia, 2014).

Montessori designed manipulative materials such as number shapes and geometric insets which helped to integrate mathematical learning with other areas of learning such as writing (Saracho & Spodek, 2008).

In the mid-20th century, early childhood mathematics education was influenced by the philosophy of Jean Piaget (May, 2016). Piaget theorised that children construct mathematical knowledge as they interact with the world (Hachey, 2013). He believed that children develop mathematical concepts as a result of their reflections on their actions (van den Heuvel-Panhuizen & Elia, 2014). Piaget's emphasis was on the connection between the structures of mathematics and children's mental structures which, according to him, developed through 'reflective abstraction' (Saracho & Spodek, 2008, p. 17). Piaget postulated that children's rational thinking developed out of the spontaneity of their play as they interacted with concrete objects (May, 2016). This theory led teachers to develop teaching practices which involved hands-on activities to assist children to engage in mathematical processes (Saracho & Spodek, 2008).

The ideas of Piaget and other pioneers of early childhood mathematics led to the current awareness of the significance of mathematics education in the early years (van den Heuvel-Panhuizen & Elia, 2014). Indeed, research shows that the mathematical knowledge children acquire at an early age will determine their mathematical achievement later on in life (see e.g. Denton & West, 2002; Krajewski, 2005).

2.6 Early Childhood Mathematics Experiences

According to Montague-Smith et al. (2017), children start recognising patterns, shapes and the difference between small and large objects from birth. Indeed, several studies have been carried out showing that children possess an aptitude for mathematics from an early age (Stipek, 2013). As early as 1967, Widom and Ginsburg carried out a study with 4-year-old children that showed that at such a young age, the participants were quite accurate in estimating proportion and they were also able to discriminate proportions (Widom & Ginsburg, 1967). In another study, carried out by Rochel Gelman in 1972, it was reported that 3 to 6 year old children possess a concept of small numbers and are able to treat small numbers as invariant (Gelman, 1972). A more recent study carried out by Gervasoni and Perry (2013) with 125 preschool children revealed that, although children had no formal education, many of them had already developed spatial understanding and measurement reasoning.

Hachey (2013) claims that children's everyday interactions with the world provide them with opportunities to engage in mathematical reasoning. According to Linder et al. (2011), it comes 'natural' to young children to compare quantities of objects or to engage in problem solving activities while they are playing. Hence, Linder et al. (2011) recommend that this informal way of developing mathematical skills has to be fostered at school by providing mathematics education that makes learning meaningful for children. The NCTM (2000) also suggests that mathematics learning can be enhanced – for all students - through the use of technology. Furthermore, the use of technology may give students with special educational needs access to mathematics they might not otherwise experience (NCTM, 2000). It is therefore important that the mathematics curriculum is developed in such a way that the learning that takes place

makes children feel competent in mathematical thinking and helps them to view mathematics as relevant to their everyday life (Sarama & Clements, 2009).

The National Council of Teachers of Mathematics (NCTM) (2000) outlined 5 content standards and 5 process standards for the mathematics curriculum. The content standards are *number* and *operations*, *algebra*, *geometry*, *measurement* and *data analysis* while the process standards are *problem solving*, *reasoning and proof*, *communication*, *connections* and *representation* (NCTM, 2000). The process standards are not to be developed on their own but are to be integrated into the content standards so that students draw on them to acquire mathematical content knowledge with deeper understanding (Sarama & Clements, 2008). Although each of the content standards and process standards apply to every year of schooling, there are content standards which are emphasised more in particular years (NCTM, 2000) as is the case for number operations in the early years (Sarama & Clements, 2009).

2.6.1 Mathematics content standards

Number and Operations

A content area which is considered important at early childhood level is number and operations (Dunphy, 2007; Sarama & Clements, 2009; van Oers, 2014). At this early stage in their lives, children start developing an understanding of number (NCTM, 2000), and how they can make use of it in their everyday lives (Dunphy, 2007). The teacher's role is to create learning opportunities which assist children in strengthening their number sense (NCTM, 2000). For example, the teacher can help children to develop their understanding of cardinality by involving them in tasks through which they come to understand that the last number stated in a count indicates the amount in a set. Through play activities, teachers can

also help children develop the concept of conservation by helping them to understand that, for example, the count of a set of blocks remains the same even if the blocks are spread out or stacked on each other. Sarama and Clements (2008), highlight that to have a good number sense, children must also develop and connect other competencies such as counting, subitising, ordering and comparing. Children need to be aware of the way numbers are related to one another, what they mean and represent in different contexts, and how they can be linked to different operations (Anghileri, 2006). Developing number sense helps students to become aware that operations have specific properties which lead to algebraic thinking (NCTM, 2000).

Algebra

Young children engage in algebraic learning mainly when they are dealing with pattern (Sarama & Clements, 2008). Even before they start school, children develop concepts related to pattern, through for instance, songs and rhymes (NCTM, 2000). These concepts are further developed at school, when the children start experimenting with patterns in various ways, including creating and repeating combinations of colours and/or shapes (Montague-Smith et al., 2017). Young children's engagement in tasks that include pattern, leads to higher order thinking as they try to identify similar and different objects and the right sequence to continue the pattern (Tsamir et al., 2020).

Geometry

The content area of geometry is considered as the second most important area in young children's mathematical learning since, besides being an important concept in itself, it is also directly linked to number and arithmetic (NCTM, 2000; Sarama & Clements, 2009). The

importance of geometry is also highlighted by Montague-Smith et al. (2017), when they claim that young children's acquisition of knowledge of shape and space will lay the foundation for the development of geometric skills as they progress through school. Children develop the concepts of shape and space as they explore the environment around them (NCTM, 2000). Educators can support this development by creating learning opportunities in class which may include understanding position and movement, the properties of 2D and 3D shapes and composing and decomposing shapes (Montague-Smith et al., 2017).

Measurement

Measurement is regarded as a fundamental mathematical concept that is widely used in everyday life (NCTM, 2000; Mellone et al., 2020). Moreover, measurement connects two important mathematical content areas namely, number and geometry (NCTM, 2000; Sarama & Clements, 2009). Measuring involves a range of concepts which include length, weight, capacity, area, volume and time (Smith, 2006). Children start dealing with the concepts of measurement from a very young age as they make direct comparison between two objects (Sarama & Clements, 2008). They start using language like *long* and *short*, *big* and *small*, *empty* and *full (and longer, shorter etc.)*, which not only helps in the development of language, but also enhances their development of mathematical concepts (Sarama & Clements, 2008). In the classroom, the teacher needs to build on the children's informal knowledge of measurement by providing hands on experience, wherein children can compare concrete objects and give more meaning to the language of size (NCTM, 2000).

Data Analysis

Data analysis involves the collection, representation and analysis of information to solve problems and answer questions (Montague-Smith et al., 2017). Young children's experience with data handling is developed when they start comparing, sorting and counting objects (Smith, 2006). Cross et al. (2009) maintain that in order for children to sort and match correctly they need to understand the concept of the component they are comparing, for example sorting by colour, shape or height. However, according to Vygotsky (1986) there are certain concepts, such as height and area, which are difficult for young children to understand. Thus, at kindergarten level, children should start handling data in an informal way, for example sorting their lunch boxes by colour and counting them. The KGE can then focus the children's attention on other attributes of the object such as size, helping the children to understand that things can be classified and represented according to different criteria (NCTM, 2000). According to Sarama and Clements (2008) it is important that young children represent data using physical objects so that they have a better understanding of the information presented.

2.6.2 Mathematics process standards

Problem Solving

The NCTM (2000) describes problem solving as the act of "engaging in a task for which the solution method is not known in advance" (p. 52). According to Shiakalli and Zacharos (2012) solutions to problems are likely to be reached when children draw on their knowledge and experience to develop new understandings. Thus, in early childhood settings, mathematical problem solving learning opportunities should be linked to the children's everyday experiences (Cross et al., 2009). Indeed, Rogers (2004) highlights that practical everyday

activities are more likely to make children "feel confident to formulate personal (and eventually conventional) problem solving procedures on the basis of enjoyment and real understanding" (p. 29). As such, teachers in early childhood settings should create learning opportunities linked to children's experiences which encourage critical thinking (Lopes et al., 2016). During such learning opportunities the teacher observes and listens to the children's interactions and further extends their thinking through questions and prompting (Faust, 2010).

Reasoning and Proof

Krummheuer (2018) describes reasoning as "the specific kind of explanation that a child connects with its activities concerning a mathematical concept" (p. 113). This is in line with Sarama and Clements' (2009) view that the act of explaining and justifying mathematical assertions help children to develop their reasoning skills. According to the NCTM (2000), children start to develop their mathematical reasoning from a very young age. Thus, at kindergarten level, teachers need to recognise the mathematics emerging from the children's play and interact with the children to encourage them to describe their thoughts (Lembrér et al., 2018). For example, during play children may be engaged in creating different patterns with coloured blocks. The teacher can prompt and question students to lead them to explain their thinking and justify the change in pattern (NCTM, 2000).

Communication

Sfard (2001) maintains that "putting communication in the heart of mathematics education is likely to change not only the way we teach but also the way we think about learning and about what is being learned" (p. 13). Indeed, the NCTM (2000) recommends *Communication* as one

of the process standards in a mathematics curriculum, outlining that "[c]ommunication is an essential part of mathematics and mathematics education" (p. 60). Children can communicate their mathematical thinking in different ways including through the use of language, gestures and symbols (Cross et al., 2009). As children interact with their peers and adults, they are able to discuss and express their mathematical thoughts which in turn can further develop their learning (Huth, 2014). According to Birklein and Steinweg (2018), in early childhood contexts, communication is enhanced when learning opportunities are embedded in play activities.

Connections

According to the NCTM (2000), key to the development of mathematics learning in early childhood education is forging a connection between the children's informal mathematics experiences and the mathematics content they are taught in school. Thus, teachers need to create learning opportunities derived from the children's interest that connect mathematics to their everyday experiences (Kinnear & Wittman, 2018). Connection in mathematics learning can also be made between different mathematical concepts, for example by connecting number to geometry when children count the sides of 2D or 3D shapes (Clements et al., 2004). Mathematics learning can also be connected with other learning areas (Lee & Ginsburg, 2009) such as physical education, literacy and creative arts. For example, physical education can be linked to mathematics by having children count the number of times they bounce a ball (NCTM, 2000). Connections to mathematics can also be made through storytelling. For example, during the story of Goldilocks and the three bears, children can be exposed to comparing the size of the bears, chairs and beds (Ginsburg et al., 2018).

Representation

According to Bobis and Way (2018) "children's representations of their mathematical experiences occur as a natural part of their everyday lives, […] in a variety of forms including drawings, play, writing, gesturing and more recently digital productions" (p. 55). For young children, representations can be viewed as a means to communicate with others and also to organise their mathematical thoughts and knowledge (Shiakalli & Zacharos, 2012). This is in line with Diezmann and McCosker's view (2011) who sustain that children's representations present educators with opportunities to explore and interpret what the children are thinking. However, van Oers (2010) argues that the educator has to be careful not to misinterpret students' representations. Thus it is important that teachers listen to the children's explanation of their representations and through questioning and prompting lead children to make the connection with mathematics (NCTM, 2000).

The content and process standards proposed by the NCTM (2000) are all relevant to early childhood education. When we look at the local scenario, since the curriculum for the Early Years is focused on an integrated approach to teaching and learning, subject learning areas are not identified (MEDE, 2015). However, there are a number of learning outcomes which refer to mathematical content and processes. Following are some examples of learning outcomes proposed in the LOF (MEDE, 2015) with reference to content and process standards recommended by the NCTM (2000).

- *I can identify, sort, group, sequence classify and organise objects in play activities* (MEDE, 2015, p. 14) – *Data Analysis content standard*.
- *I explore and use number in meaningful activities e.g. concept of number, value etc.* (MEDE, 2015, p. 10) – *Number and operations* content standard.

- *I can apply the mathematical concepts which I have mastered to solve real-life and mathematical problems* (MEDE, 2015, p. 20) - *Problem Solving* process standard.
- *I have learnt to see symbols as a means of representation e.g. numbers, letters, signs* (MEDE, 2015, p. 13) – *Representation* process standard.

Gasteiger (2014), stresses the importance of providing mathematical experiences in kindergarten settings, since these help children gain basic mathematical competencies. Thus, kindergarten educators need to develop a coherent curriculum, aligning age-appropriate mathematical content and suitable pedagogical practices with the recommended learning outcomes. Furthermore, Gasteiger (2014), poses an important question regarding what type of learning should be followed in early mathematics education, whether it should take an instructive or constructive approach.

2.7 Instruction and Construction in Early Mathematics Education

The pedagogical approaches of *instruction* and *construction* in regard to the teaching of mathematics in the early years have been a cause for debate for quite some time (Stipek, 2013; Chen & McCray, 2014). Chen and McCray (2014) define instruction as a way of teaching where the teacher imparts knowledge and the learners are passive, or 'on the receiving end'. This definition is similar to what Rogoff et al. (2003) termed as *assembly-line instruction* where knowledge is transmitted by the teacher "outside the context of productive purposive activity" (p. 176). This indicates that during direct instruction teachers are most likely to ask children to do a specific action and/or ask closed questions leaving little space for children to wonder and investigate (Breive et al., 2018). Lange et al. (2014) explain that although direct

instruction in early childhood settings may still be enjoyable for children, it hardly allows children to make choices. On the other hand, Presmeg (2014) maintains that at times students may not be aware of certain mathematical conventions and that therefore it is through "effective instruction" (p. 11) that they can obtain "mathematically accepted knowledge" (p. 11).

In contrast to instruction, the process of construction allows learners to develop their own knowledge and skills, making them active agents in their learning (Smith, 1999). Similarly, Chen and McCray (2014) explain that individuals construct knowledge through active participation and the process involves self-discovery and exploration. A strong advocate of the constructivist view to learning is Constance Kamii (2006) who grounds her claims on Piaget's writings. Thus, she distinguished between three kinds of knowledge: physical knowledge, social-conventional knowledge and logico-mathematical knowledge (Kamii, 2006). Children acquire physical knowledge through observations of actual objects, such as knowing that leaves are green (Chen & McCray, 2014). Social-conventional knowledge is acquired through conventions among people such as knowing that we use kilograms and grams for weight. Logico-mathematical knowledge is based on physical knowledge but goes beyond it. Recognising that a blue pencil and a red pencil have different colours is physical knowledge but the difference in the length of the pencils is logico-mathematical knowledge (Kamii, 2006). In their explanation of Kamii's work, Chen and McCray (2014) state that although children need teachers to obtain knowledge of mathematical content, mathematical understanding is acquired through the "mental construction process" (p. 261) of the learner.

Thus, Anderson and Anderson (2018), sustain that in an early childhood context, where the construction of knowledge is promoted, the teacher's instruction should be embedded in child-centred activity. Lee and Ginsburg (2009) argue that mathematical learning does not occur incidentally and it is not enough that teachers provide a stimulating environment rich in mathematics resources, but they also have to intervene for children to acquire mathematical competencies. According to van Oers (2014), the teaching of mathematics should be a blend of instruction from the teacher and construction from the learner, and it is up to the teacher to find the right balance. Children may not be aware of certain mathematical concepts and processes and teachers can transmit this knowledge through effective instruction whilst children are being creative and enjoying themselves (Presmeg, 2014). This is in line with Vygotsky's (1978) argument that, for children to move from their current knowledge to a new state of knowledge, they need a *More Knowledgeable Other* (MKO), someone who has more knowledge than the children. This collaboration between the teacher and the learner can be created through a play-based curriculum (van Oers, 2014).

2.8 Mathematics Learning through Play

The importance of play in child development was recognised by pioneers of early childhood education like Montessori, Steiner, Froebel and Isaacs, where play was central to their work in the development of the curriculum (Nutbrown, 2006). It is the natural way that children engage in play that makes it a key element to their development and learning (Manning-Morton & Thorp, 2004; Wood, 2008; Moyles, 2013; Nutbrown & Clough, 2014). Stacey (2009) sustains that play arouses in children the urge for exploration and investigation, which are elements conducive to learning. The fun way in which children participate in play activities helps them to develop a disposition to learn, they are "learning to learn" (Langston & Abbot,

2005, p. 35). Teachers need to observe and listen to children's play interactions to gain insight into their level of understanding, knowledge and skills, and in turn they learn from the children themselves how to best support their development (Moyles, 2013; Ambery & Steinbrunner, 2016).

A psychologist who made a considerable contribution to the theory of play and its significance to early childhood development is Piaget (Garwood, 1982). From observations he carried out on his own children at play and of a study he conducted of older boys playing marble games, Piaget concluded that there is a connection between intellectual development and play (Carlisle, 2009). He proposed three levels of play development: sensorimotor (from birth to two years), symbolic (from 2 to 7 years) and games with rules (from 7 to 11 years) (Garwood, 1982). At the sensorimotor level, children use their senses to understand the world around them and play helps them develop skills including spatial awareness and eye-hand coordination (Andrews, 2012). In the symbolic level, children start making use of symbols, including pictures and words, to describe the world around them (Garwood, 1982). At this stage Piaget highlights pretend play as dominant in children's play (Bergen, 2015) and he further theorises that pretence develops knowledge construction (Bergen, 2014). At the third level, Piaget maintains, that children's interest in games is conducive to the development of logical thought (Andrews, 2012). Children engage in reasoning skills as they think of different strategies to play the game, such as which are the best moves to make to win a board game (Carlisle, 2009).

Another psychologist who theorised about child development and play is Lev Vygotsky. He maintained that although play is not the main factor that comprises childhood, it is critical to

childhood development (Vygotsky, 1967). He sustained that "children move forward essentially through play activity" (Vygotsky, 1978, p. 103), as play provides the right opportunities for children to develop. He theorised that children's development is an interplay between the natural process of growth and the cultural development created through children's interactions with other people (Vygotsky, 1978). Vygotsky viewed early childhood as the time where the elementary mental processes are at the preliminary stage and children develop these processes to a higher level through social interactions (Bodrova & Leong, 2015). According to Vygotsky, a higher level of mental development is reached when children internalise their modes of behaviour, as they progress from acting impulsively to acting intentionally (Vygotsky, 1978). Vygotsky further highlights that this progression to a higher intellectual level can be achieved through play (Wong & Logan, 2016).

Vygotsky's theory on play and its key role in childhood development focused on *imaginary* play, especially pretend role-play (Bergen, 2014). Pretend role-play, according to Vygotsky, can be a means for children to acquire cultural knowledge (Worthington, 2018). Vygotsky explained that imaginary play is regulated by cultural and social norms as children act out social roles (e.g., a teacher, a sister) and abide by social rules related to the imaginary role (Verenikina et al., 2003). In this imaginary situation, children follow rules of behaviour which they do not necessarily follow in real life (Duncan & Tarulli, 2003). In Vygotsky's words, the child acts "as though he were a head taller than himself" (Vygotsky, 1978, p. 102) as they behaves above his actual age and usual behaviour. Vygotsky presented three stages of imaginary play; first, the child imagines a situation, then they acts out the role pertaining to that situation which then leads to following the rules bound to that role (Vygotsky, 1967). As such, imaginary play leads children to act beyond their intellectual capabilities as they

progress from elementary thought processes to more complex symbolic thought (Bodrova & Leong, 2015).

Vygotsky also highlights that during play children separate thought from objects as their actions are derived from ideas rather than from the things they are playing with (Vygotsky, 1978). According to Vygotsky (1967), the play objects serve as 'pivots' which lead children to transfer the actual meaning of the object to an imaginary or abstract one. Vygotsky (1967) gives the example of a stick used by a child to represent a horse. The child already has a picture in his mind of a horse they has seen and, during play, the child uses a stick imagining that it is a horse. The stick becomes the 'pivot' as the child "severe[s] the meaning of horse from a real horse and transfer[s] it to a stick" (Vygotsky, 1967, p. 13). In this way, the object loses its real meaning and the child "learns to act in a cognitive, rather than externally visible realm, relying on internal tendencies and motives, and not on incentives supplied by external things" (Vygotsky, 1967, p. 11). From Vygotsky's perspective, imaginary play helps children to make connections between spontaneous and scientific concepts (Vygotsky, 1987). Drawing on Vygotsky, Worthington and van Oers (2016) explain that through imaginary play children draw on their cultural knowledge and are exposed to spontaneous (everyday) concepts, such as pretending to shop for food. The situation provides a context for the development of scientific concepts such as engaging in mathematical reasoning to buy and sell products (van Oers, 2014).

Worthington and van Oers (2016) sustain that children's spontaneous imaginary play "uncovers the emergence of cultural mathematical understandings" (p. 63). This is consistent with Linder et al.'s (2011) view that play is key to helping children foster mathematical

concepts. However, Lee and Ginsburg (2009) argue that while play may lead to some mathematical learning, children need to be guided to engage in mathematical thinking. This was also sustained by Farrugia (2020), in a study she carried out with 4 year old children in a Maltese kindergarten setting which illustrated that adult intervention is required for children to engage in mathematical talk and action during play.

Whilst emphasising the importance of play in early childhood education, Weisberg et al. (2015) sustain that the best approach to reach specific learning goals is through guided play. These authors distinguish between three types of play: free play, which is initiated and directed by the children, direct instruction, which is initiated and directed by adults, and guided play, which is initiated by adults and directed by the children (Weisberg et al., 2015). In guided play, the educator structures the activity in such a way as to leave children free to play while finding opportunities to lead them to engage in inquiry based learning (Breive et al., 2018). According to Lee and Ginsburg (2009) guided play can also present situations for teachers to assist children to evolve their informal mathematical knowledge to a more advanced stage. A study carried out by Lange et al. (2014) showed how the interplay of children's play, teacher intervention and scaffolding created mathematical learning opportunities where children were engaged. In this study, while young children played and explored with glass jars, the teacher elaborated on their interest and asked questions, which led to the children's engagement of mathematical content, including shapes, sorting and ordering. The relation of guided play and mathematical inference was also substantiated in a study by Ferrara et al. (2011), who sustained that children who engaged in guided play using blocks made more use of spatial language than children who engaged in free play using the same resources.

Play in early years education, is viewed as an important pedagogical tool (Wong & Logan, 2016), as it provides the right setting for children to engage in mathematical learning under adult guidance (van Oers, 2014). Play is regarded as an important tool that facilitates the process for children to acquire a number of skills and grasp different concepts (Moyles, 2013). Teachers need to create play-based learning opportunities to enhance the children's existing mathematical knowledge and guide them to grasp new concepts (Lange et al., 2014). The Malta NCF emphasises that in the Early Years cycle suitable pedagogies involving play should be used to foster learning (MEDE, 2012). At kindergarten level, kindergarten educators need to develop learning opportunities, using play as the main tool, to help children to achieve the learning outcomes.

2.9 Conclusion

This chapter discussed key 20th century developments in Maltese education, mainly, kindergarten provision and the curriculum in the early years. It also explored how the Early Years curriculum is to be developed through project work, based on an emergent curriculum approach. In addition, Mathematics education in early childhood was discussed, highlighting the importance of providing children with opportunities to engage in meaningful mathematics learning at school. The notion of instruction and construction in the teaching of mathematics was also explored and reference was made to the mathematics content and process standards as outlined by the NCTM (2000) and their relevance to the Early Years mathematics related learning outcomes proposed in the LOF. Finally, the significance of play for children's learning and development, making special reference to mathematics learning was discussed. In the next chapter I will present the theoretical framework which guides my study.

Chapter 3: Theoretical Framework

3.1 Introduction

The aim of the study is to investigate how mathematical concepts and processes can be integrated into children's learning experiences at KGII level. It is an action research carried out in collaboration with four KGEs. I will be conducting focus group discussions and stimulated recall interviews with the KGEs to devise a plan to address mathematics learning. The plan will include learning opportunities, as part of ongoing projects, where mathematical learning outcomes mentioned or implied explicitly in the LOF, can be addressed. The focus group discussions and stimulated recall interviews will also serve to support the KGEs in the implementation of the plan. I will also conduct classroom observations as I wish to discover, how children develop their mathematical learning in a classroom environment and the contribution of the KGEs towards this development. This leads me to adopt, as my theoretical perspective, Vygotsky's sociocultural theory of teaching and learning.

3.2 Vygotsky's Sociocultural Theory

Vygotsky's sociocultural theory is grounded in the notion that culture and the social environment have an impact on learning and development (Silalahi, 2019). Vygotsky (1987) maintained that culture shapes the way children experience the world and he highlights the importance of social interactions for children's mental development. According to Vygotsky ''learning awakens a variety of internal developmental processes that are able to operate only when the child is interacting with people in his environment and in cooperation with peers'' (Vygotsky, 1978, p. 90). Furthermore, Vygotsky postulated that the interaction of children with adults and their peers during preschool years facilitates the process for children to learn

and develop their higher mental processes (Bodrova et al., 2013). From my professional experience, working in an early years and primary setting I, too, believe that children's learning is enhanced within a stimulating environment, in synergy with the educator and other students.

I considered my project to serve as a process of development, for both the KGEs and the children under observation. As I stated earlier, my study involves an action research approach. Action research is described by Bradbury et al. (2019) as ''transformative social learning'' (p. 7). Thus, when I analyse my data of the focus group discussions and the stimulated recall interviews, I would look for examples of how the collaborative approach altered the KGEs learning and professional development. On the same lines, when I analyse the classroom observations and related field notes, I will explore in what way the children moved forward in their learning. I therefore choose to base my research on key terms used by Vygotsky or associated with his works. These are:

- The More Knowledgeable Other (MKO)
- The Zone of Proximal Development (ZPD)
- Scaffolding, which although a term not actually used by Vygotsky, is a notion associated to the ZPD (Olney, 2014).

In the next sections, I will explain the meaning of each term and its significance to my research analysis.

3.3 The More Knowledgeable Other (MKO)

Vygotsky believed that humans learn through social interaction with a more knowledgeable other (MKO) (Vygotsky, 1978). The MKO is referred to by McLeod (2018), as '' someone who has a better understanding or a higher ability level than the learner, with respect to a particular task, process, or concept'' (p. 5). Vygotsky postulated that collaboration, guidance and help from a MKO can help a child to do more than he is able to do independently (Chaiklin, 2003). When we look at the classroom scenario, the person who is more knowledgeable and more able to carry out a task, can be the teacher or a more expert peer (Smidt, 2009). Chaiklin (2003), argues that one must not only consider the competence of the MKO but also to what extent the MKO's assistance is effecting the child's learning. This links to the main aim of my study, as I wish to investigate how the interventions of the MKO, in my case the KGE, effected the children's learning and development of the mathematical concepts and processes. In addition to this, the knowledge I have derived from the literature, my professional experience and professional development sessions I attended, puts me in the position of the MKO during the focus group discussions and the stimulated recall interviews. In my analysis I sought to explore how my guidance during these sessions assisted the KGEs in their professional development. McLeod (2018) sustains that the concept of the MKO is directly related to Vygotsky's concept of the Zone of Proximal Development (ZPD).

3.4 The Zone of Proximal Development (ZPD)

Vygotsky's theory on the significance of social influences on child development and learning is further developed in his concept of the ZPD (Chaiklin, 2003). Vygotsky distinguished between two developmental levels and defined ZPD as '"the distance between the actual

developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers" (Vygotsky, 1978, p. 86). In this process, the role of the MKO is to assist children to move from their performance (actual) level to their potential level (Smidt, 2009). As Vygotsky (1978) highlighted ''what a child can do with assistance today she will be able to do by herself tomorrow'' (p. 81). Vygotsky maintained that child development is dependent on learning (Silalahi, 2019). He postulated that the learning that takes place is to be oriented towards the child's new level of development and hence ''the only 'good learning` is that which is in advance of development'' (Vygotsky, 1978, p. 89). This 'good learning` paves the way for children to internalise what they have learnt and make it their own (Smidt, 2009). Vygotsky defined internalisation as ''the internal reconstruction of an external operation'' (1978, p. 56). Internalisation is a process which is constructed by individuals as a result of the experiences they share with others in society (Bartolini Bussi & Mariotti, 2008). When individuals internalise knowledge they are moving forward in their ZPD (Tchoshanov, 2002).

Similar to Vygotsky's concept of the ZPD is the emergent curriculum approach principle which implies that teachers should move children from the known to the unknown by connecting children's prior knowledge to new learning experiences with deeper understanding (Ambery & Steinbrunner, 2016). According to Walshaw (2017), to foster children's mathematical thinking the teacher needs to make a connection between the students' actual knowledge and the new learning goal to be achieved. This is a principle which I embrace and I would like to explore how, and if, the KGEs identify the children's actual level of mathematical concept knowledge before introducing new mathematical ideas. Furthermore, I am interested to discover what strategies the KGEs apply to move children forward in their ZPD.

The ZPD concept has also been applied to teacher education (Fani & Ghaemi, 2011). Warford (2011), uses the term *Zone of Proximal Teacher Development* (ZPTD) and defined it as ''the distance between what teaching candidates can do on their own without assistance and a proximal level they might attain through strategically mediated assistance from more capable others'' (p. 253). Drawing on Gallimore and Tharp's (1990) stages of the ZPD, Warford (2011), highlighted 4 stages of the ZPTD. These are:

I. *Self-assistance*: Teachers reflect on their own classroom experience.
II. *Expert other assistance*: Interventions of the MKO through discussions and peer tutoring.
III. *Internalisation*: Teachers embrace new pedagogical knowledge and skills.
IV. *Recursion*: Teachers use the acquired pedagogical knowledge and skills repeatedly in their teaching strategies.

These stages as outlined by Warford (2011) relate directly to the action research process I will be adopting in my study. Thus, I will be analysing all the four stages in relation to how the collaboration between myself and the KGEs, through the focus group discussions and the stimulated recall interviews, leads to the educators' professional growth.

3.5 Scaffolding

Smidt (2009), suggests that scaffolding practices assist children to move to their potential level of development. The term *scaffolding* originated from the work of Wood et al. (1976), who define scaffolding as the ''process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts'' (p. 90). This implies

that the assistance given through scaffolding helps in the development of the ZPD (Silalahi, 2019). As explained by Zerafa (2020), although the term scaffolding was not used by Vygotsky, it is related to the ZPD, as the scaffolding process assists the learner to move to their potential development. Wood et al. (1976), suggest that the process of scaffolding, managed by the tutor, would have an impact "in [the] development of task competence by the learner at a pace that would far outstrip his unassisted efforts" (p. 90). In the classroom scenario, teachers apply scaffolding strategies that lead the child to develop new knowledge and once the child sustains that knowledge, the scaffolding is withdrawn (Walshaw, 2017).

Anghileri (2006) maintains that scaffolding practices enhance mathematics teaching as they support children in acquiring the understanding of mathematical concepts. She proposes three levels for scaffolding, highlighting strategies that can be applied in the classroom, which are relevant to mathematical learning. These are shown in the diagram in Figure 1.

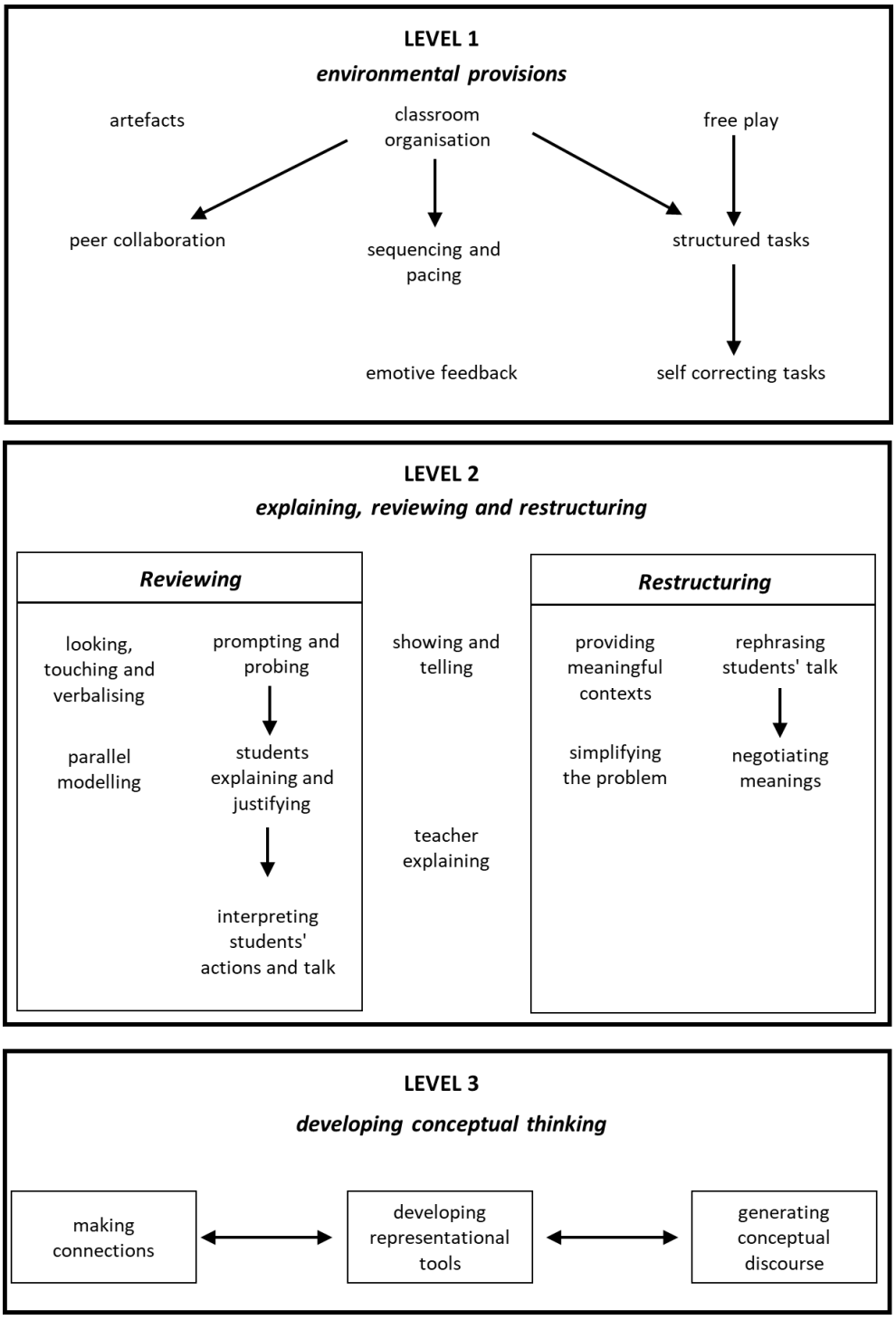

Figure 1 - Teacher Strategies for Scaffolding Learning (Anghileri, 2006, p. 39)

Anghileri (2006) proposed the three levels of scaffolding strategies for Primary school children. Therefore, during my data analysis, I will draw on Anghileri's (2006) scaffolding strategies, but adapt them to the kindergarten level. This will help me to investigate how the KGEs apply

scaffolding strategies to move children forward in their ZPD. As I explain Anghileri's (2006) strategies below, I will be providing examples of their application to a kindergarten setting.

At Level 1, the type of scaffolding suggested by Anghileri (2006) does not involve direct teacher involvement but rather the classroom environment, including the *classroom organisation, artefacts* and *free play.* This is similar to Walshaw's (2017) suggestion that teachers should create classroom environments which attract children's interest as the environment plays a major role in fostering or hindering their conceptual development. A strand of *environmental provision* is the *classroom organisation*, which includes the *sequencing and pacing* of events and the grouping of children. During my own classroom observations I wish to discover if the activities are structured in such a way so as to build on, and broaden, the children's mathematical knowledge. Furthermore, I am interested to see if the KGEs allow adequate time and opportunity for the children to develop their understanding of mathematics (NCTM, 2000). According to Anghileri (2006) the grouping of children is also important to scaffold children's learning as children can learn from each other through *peer collaboration*. This is consistent with Vygotsky's (1978) view that children's interactions with their peers help them to develop new knowledge. While observing the children during the activities, it would be interesting to see if the children's interactions lead to collaborative learning. *Artefacts* can also be a source for children to interact with adults and their peers (Bartolini Bussi & Mariotti, 2008). Anghileri (2006) sustains that *artefacts*, including wall displays and mathematics resources, can have a positive effect on the children's learning. From my own experience, while visiting kindergarten classrooms, I have seen several wall displays related to mathematics, including the number line, and have observed children playing with mathematics related resources such as shapes. I am interested to discover if the KGEs make

use of the displays and the resources to scaffold the children's learning. *Free play,* which is employed often in kindergarten classes, is also considered as a scaffolding strategy where children can "set their own challenges and learn through feedback" (Anghileri, 2006, p. 40). *Environmental provision* also include *structured tasks* which, as explained by Anghileri (2006), are often in the form of worksheets. Since at KGII level worksheets are not used, and children are not involved in writing tasks, this scaffolding strategy is not going to be considered in my study. Another scaffolding strategy is the s*elf-correcting tasks* where the KGE can modify the activity to include elements which help the children to reflect on the process and find a solution. Adapting this strategy to my study, I can look for episodes such as, for example, a child finding difficulty to recognise a number from a set of ten numbers cards, and the KGE reducing the amount of number cards to facilitate the number recognition. Anghileri (2006) also included *emotive feedback* at Level 1, which I consider to be very important as actions and words of encouragement from the KGEs will boost children's self-esteem and help them move forward in their learning.

Level 2 in Anghileri's (2006) scaffolding proposal involves direct interaction of the teacher with the children by *explaining, reviewing and restructuring*. When teachers use *explaining* - including *showing and telling* - they retain control of the task and the children's contribution is minimal. Anghileri (1995) argues that one has to be careful when using these strategies as scaffolds as they can restrict students thinking. As outlined by Walshaw (2017), ''if the teacher's talk fails to keep the student's mind attuned to the teacher's, scaffolding loses its impact'' (p. 295), and therefore, the scaffolding practices of *reviewing* and *restructuring* necessitate teacher and student interaction. When applying the *reviewing* strategy, the teacher guides the learner to focus on the desired learning outcome. At this stage the

guidance of the teacher needs to be in line with the current level of understanding of the learner (Olney, 2014). There are several strategies that can be applied including *looking, touching and verbalising* which can prompt young children to handle objects and express their thoughts about them. For example, during the process of counting a number of counters, children look at the counters, touch them and say the number names. Furthermore, the KGEs can use *prompting and probing* to help the children to extend their thinking. Clements et al. (2004) hold that prompting and asking open-ended questions help children to engage in mathematical inquiry and thinking. Questions may also lead to *students explaining and justifying* their solutions. When students explain and justify their actions they confirm their understanding of mathematical concepts (NCTM, 2000). In addition, the teacher needs to *interpret the students' actions and talk* and if necessary intervenes to extend the students' explanations. Anghileri (2006) explains that sometimes, although the teacher applies the reviewing strategies (mentioned above), the child may still be at a loss to reach a solution. In this case, the teacher applies the *parallel modelling* strategy by showing the child how to reach the solution. Furthermore, children can also be the ones to parallel model for their peers. In my analysis I will look for episodes where the KGEs applied the above mentioned *reviewing* strategies to scaffold the children's mathematical learning.

After *reviewing*, the next step would be for the teacher to assist the learners to move forward in their current level of understanding by *restructuring*. The *restructuring* strategies create a shared understanding of knowledge between the learner and the teacher, which serve as the foundation to lead the child to a higher level of development (Verenikina, 2003). According to Anghileri (2006), teachers can alter the learner's level of understanding by *providing meaningful contexts*. In an early years setting it is important that children experience

mathematics learning in contexts which are relevant to them (NCTM, 2000). For example, the KGE can use the story *The Three Billy Goats Gruff* to expose children to the concepts of distance and measurement. The KGEs can also scaffold the children's learning by *simplifying the problem*. If a child, for instance, encounters difficulty to continue a sequence of 4 different sets of shapes, the KGE can simplify the task by reducing the number of different shapes. Anghileri (2006) also proposes the strategy *rephrasing student's talk* to introduce and extend the children's formal mathematical language. Young children may for example use the word *smaller* to refer to something which is *shorter* and the KGE rephrases the word using the right terminology. The strategy *negotiating meanings* is explained by Anghileri (2006) as a whole class process where the teacher and the children discuss, interpret and develop their mathematical knowledge. This will provide the children with "opportunities to share their thinking with others, encourage [them] to reflect on their methods and language they themselves use and become aware of alternative interpretations and strategies" (Anghileri, 1995, p. 14). This strategy may be difficult for the KGEs to apply since the children are very young and it can be challenging to engage them in a whole classroom discussion. Therefore, in my analysis I will focus on how the KGEs *provid[e] meaningful contexts, simplify the problem* and *rephrase student's talk* to enhance their mathematical learning.

The highest level of scaffolding in Anghileri's (2006) scaffolding strategies (level 3), involves *developing conceptual thinking* by *making connections*, *generating conceptual discourse* and *developing representational tools*. Anghileri (2006) explains that it is important that the teacher assists children to *make connections* between different mathematical ideas. However, at KGII level, the children's mathematical knowledge is somewhat limited and thus, in my analysis, I will adapt this strategy to include children *making connections* to their

everyday lives. As explained by Kinnear et al. (2018), when children make connections to their previous experiences, they use this ''interconnected knowledge'' (p. 2) and apply it to new situations resulting in the acquisition of new understandings.

To extend thinking, teachers need to engage children in *conceptual discourse*. Teachers scaffold children's learning to internalise mathematical concepts by assisting them to progress from making statements about mathematical procedures to reasoning out the procedures (Kazemi, 1998). This can be done through questioning so that children will reflect and as a result engage in meaningful discourse (Anghileri, 2006). Discussions at this stage are important, as children will be able to share their mathematical thoughts with their peers, generating mathematical reasoning. However, since my study involves KGII children, it may not always be possible to engage children in *conceptual discourse* due to their limited speech and thus this strategy will not be considered in my analysis. Finally, a central strategy in Anghileri's (2006) scaffolding hierarchy is *developing representational tools*. She explains that representational tools, including words, symbols and images, can become 'tools for thinking' as children attach meaning to them (Anghileri, 2006).

Anghileri's (2006) strategy *developing representational tools* is in line with Vygotsky's (1981) notion of cultural tools, since Vygotsky maintained that cultural tools influence the child's development and learning as they are the source of internalisation. Vygotsky distinguished between two types of tools; technical tools and psychological tools. Technical tools are termed by Vygotsky as *tools of labour*, which include tangible objects such as blocks, number cards and rulers (Blunden. 2015). Vygotsky (1978) maintained that technical tools are "externally oriented" and they serve as "a conductor of human influence on the object" (p.

55). For example, pegs can be used as tools to hang the correct number on a number line. They are utilised solely to carry out an activity thus making them technical tools. On the other hand psychological tools are "internally oriented" (Vygotsky, 1978, p. 55) and influence human behaviour. Examples of psychological tools as outlined by Vygotsky are ''language; various systems for counting, mnemonic techniques, algebraic symbol systems, works of art, writing, schemes, diagrams, maps and mechanical drawings, all sorts of conventional signs, etc.'' (Vygotsky, 1981, p. 137). Psychological tools act as mediators in the learning process and help children to internalise mathematical content (Kinard & Kozulin, 2008). Thus, for example counters can be used to count out an amount, thus helping the children to internalise the concept of value.

Vygotsky emphasised the importance of speech in facilitating the manipulation of tools (Vygotsky, 1998). Thus, both the action of using the tool and the use of language in relation to that action are important in achieving "new forms of behaviour" (Vygotsky, 1999). Therefore, it is important that children are exposed to mathematical language from a young age. In the case of very young children, the NCTM (2000) recommends that mathematical language should be connected to their informal language in meaningful contexts. During the classroom observations I wish to discover the tools (resources and language) used by the KGEs to assist children to acquire mathematical knowledge.

My own role as the MKO put me in a position to provide scaffolded guidance to the KGEs themselves. As a theoretical framework for this relationship, I have found helpful Wood et al.'s (1976) recommended six functions in the scaffolding process. Although in their study,

Wood et al. (1976) referred to the application of these functions to scaffold children's learning, I believe that they can also be employed to scaffold adults' learning as I will explain hereon.

- *Recruitment* – generating the KGE's interest in the task.
- *Reduction in degrees of freedom* – simplifying the task to help the KGEs reach a solution.
- *Direction maintenance* – offering support and guidance to assist the KGEs to focus on the objective of the task.
- *Marking critical features* – highlighting discrepancies between what the KGEs have produced and the ideal way the task is to be carried out.
- *Frustration control* – minimizing the KGE's frustration by providing encouragement to complete the task.
- *Demonstration* – demonstrating the ideal way the task should be carried out.

Thus, during my research project I, as the MKO, and by drawing on Wood et al.'s (1976) functions of scaffolding processes, will provide a framework for the KGEs to engage in an action-reflection process to assist them to move ahead within their ZPTD. However, I must highlight that the function *Demonstration* cannot be applied in my research. This is because, since the study was taking place in the middle of the COVID-19 pandemic, the restrictions employed during the pandemic did not allow the KGEs to visit each other's classes to observe good practices and I myself could not demonstrate.

3.6 Conclusion

In this chapter I have explained the theoretical approach to my study, based on key concepts associated with Vygotsky's sociocultural theory, and the relevance of these concepts to my research project. In the next chapter I will discuss the research design adopted for the study

including my philosophical position, the methodology applied and methods used to gather the data. I will also explore the ethical issues to be taken into consideration when research is conducted in a school, involving educators and children.

Chapter 4 - Research Design

4.1 Introduction

"Specifically, scientific educational research is defined as the application of systematic methods and techniques that help researchers and practitioners to understand and enhance the teaching and learning process" (Lodico et al., 2006, p. 4).

In this chapter I will present the approach I took to conduct my research to address the following research questions:

- *How can a member of the School Leadership Team work collaboratively with kindergarten educators to support them in their professional growth?*
- *How can this collaboration help kindergarten educators to devise a plan to incorporate the mathematical concepts and processes mentioned, or implied, in the Learning Outcomes Framework document for the Early Years (Levels 1-3) into the project approach?*
- *How can this collaboration support the implementation of the plan in the classroom, to provide children with opportunities to learn mathematics?*

Creswell and Creswell (2018) highlight that a research approach involves the interaction of philosophical views, the related research design and the methods used. Thus, I will give an overview of the framework of my research, outlining the research paradigm which underpins my study, the methodological approach and the methods adopted. I will also discuss the ethical issues I took into consideration in relation to my research.

4.2 Research Paradigms

Research paradigms provide a framework as guidance for researchers to address a problem and to apply theories and methods to solve that problem (Usher, 1996). This framework involves "a loose collection of logically related assumptions, concepts, or propositions that orient thinking and research" (Bogdan & Biklen, 2007, p. 24). According to Guba and Lincoln (1994), paradigms are framed around three questions; the ontological question, the epistemological question and the methodological question. These questions are explained as follows:

- The ontological question relates to "assumptions about the nature of reality" (Saunders et al., 2016, p. 127), that is, in what way do people view the world around them?
- The epistemological question is concerned with knowledge, how human beings acquire knowledge (Usher, 1996), and the claims of "how can what is assumed to exist be known?" (Waring, 2017, p. 16).
- The methodological question relates directly to the ontological and epistemological assumptions the researcher makes, mainly, what approach does the researcher take, and what are the logic and procedure to be followed, to address the ontological and epistemological assumptions? (Guba & Lincoln, 1994).

Grix (2002) postulates that the starting point of any research is that the researcher outlines their ontological position of their research, followed by their epistemological and finally, the methodological position. Therefore, before I started my research, I needed to first explore different paradigms to see which best fits with my ontological beliefs and epistemological

assumptions. I chose to explore two paradigms suggested by Waring (2017), the positivist paradigm and the interpretive paradigm.

4.2.1 The positivist paradigm

A name synonymous with positivism is Auguste Comte (1798-1857) who adopted the methodology used to investigate natural sciences and adapted it to understand human behaviour (Tekin & Kotaman, 2013). The positivist philosophy is based on the premise that we can investigate the social world in the same manner that we investigate the natural world (Mertens, 2014). Additionally, positivists hold that studies of the social world should be derived from facts (Bryman, 2012). Hence, the ontological position within the positivist paradigm is that "social phenomena and their meanings have an existence that is independent of social actors" (Grix, 2002, p. 177). Only one reality exists which is the same for every individual (Ryan, 2018). Epistemologically, the positivist researcher is objective and focuses on phenomena that can be observed and measured, leading to knowledge which is credible and meaningful (Crotty, 1998). This indicates that the knowledge developed must be free of the researcher's or the participant's values (Park et al., 2020). Lodico et al. (2006) sustain that, typically, knowledge within a positivist position is acquired through a *hypothetico-deductive* approach. Applying the *hypothetico-deductive* approach, the researcher formulates a hypothesis based on theory or knowledge derived from previous studies, designs a structured tool, such as an experiment or survey, to test the hypothesis and conducts the experiment to gather the data (Park et al., 2020). The findings from the study will confirm or reject the hypothesis (Bryman, 2012). Since the methods used to gather the data are considered as objective, the findings are deemed as valid and reliable knowledge (O'Donaghue, 2007).

Hence, the data gathered can be used to create law-like generalisations that can be applied to different groups of people or situations (Saunders et al., 2016).

4.2.2 The interpretive paradigm

Crotty (1998) highlights that interpretivism arose in antithesis to positivism, in an attempt to understand the reality of humans and society. Interpretivism is synonymous with Max Weber's (1864-1920) notion of *Verstehen* (understanding) (Bryman, 2012). Weber highlights that one has to understand the meaning people give to their actions in order to understand the cause of the action (Ryan, 2018). The interpretive position assumes that "all human action is meaningful and hence has to be interpreted and understood within the context of social practices" (Usher, 1996, p. 18). This implies that meanings have to be understood and created through the interactions of individuals (O'Donaghue, 2007). Furthermore, interpretivists hold that individuals are unique, having their own "dispositions, assumptions, values and prior knowledge through which he-she constructs his-her own reality" (Tekin & Kotaman, 2013, p. 85). The interpretive paradigm is based on the ontological view of constructivism which implies that there are multiple realities constructed by individuals (Mertens, 2014). Interpretivists maintain that knowledge is derived directly from the participants, based on their subjective view (Creswell & Creswell, 2018), an epistemological assumption which contrasts with the positivists' position. Interpretivist researchers conduct their studies in the 'field', as they interact with the research participants, so that they better understand the participants' subjective experiences (Creswell & Poth, 2018). Waring (2017) maintains that the researcher and the research participants "are assumed to be interactively linked so that the 'findings' are literally created as the investigation proceeds" (p. 18). The data gathered in an interpretive approach is typically acquired through an inductive process (Bryman, 2012).

The researcher employing an inductive approach would first observe the phenomena under investigation, then the data gathered from the observations is categorised into themes leading to the analysis of those themes (Mertens, 2014). From the analysis, a conclusion or theory is derived based on the observations conducted (Saunders et al., 2016).

4.2.3 My choice of research paradigm

After considering both the positivist and interpretive paradigms I concluded that an interpretive approach is more suited for my research as I will explain hereon. My research entailed that I collaborate with 4 KGEs to explore the mathematical learning opportunities within an emergent curriculum approach. According to Tekin and Kotaman (2013), the interpretivist approach aims to understand how human beings understand social reality. The researcher interacts with the research participants to try to understand how they view the world from their own individual experience (Saunders et al., 2016). This was in line with the way I wanted to conduct my study since I wanted to discover the KGEs' thoughts and ideas about the implementation of the emergent curriculum approach and mathematics learning opportunities. My assumption was that each KGE would have her own perspectives on how she views her experience in the classroom and, as such, each participant constructs her own reality, which tallies with the interpretive ontological assumption of constructivism.

Creswell and Poth (2018) view interpretivism as a subjective philosophy where knowledge is obtained directly from the participants in their own environment. I conducted my study at the school where the KGEs worked, making it possible to gather and interpret the KGE's subjective experience in their own context, which is in line with the epistemological assumption of the interpretivist philosophy.

4.3 Methodology

Once I had established my philosophical position, the next step was to choose the methodology suited for my research, based on my ontological and epistemological beliefs. Scott (1996) defines methodology "as a distinct way of approaching research with particular understandings of purposes, foci, data, analysis and more fundamentally, the relationship between data and what they refer to" (p. 61). In other words, methodology involves the strategy taken by the researcher to make use of the most suitable methods to obtain a successful outcome to the research (Crotty, 1998). Bryman (2012) distinguishes between three types of research strategies: quantitative, qualitative and mixed methods. I will briefly explain each strategy in the following sections.

4.3.1 The quantitative research approach

Saunders et al. (2016) highlight that quantitative research is commonly associated with the positivist philosophy. This is because the quantitative researcher believes that there is only one truth, which can be discovered by using objective methods of data collection (Sukamolson, 2007). The methods employed may include standardised research instruments such as surveys, questionnaires and structured interviews (Kelle & Buchholtz, 2015). Standardisation is essential when conducting a quantitative study as it ensures that different variables are put on the same scale (Kelle & Buchholtz, 2015). The data collected from the standardised tests is usually concerned with numbers and, as such, can be analysed statistically (Sukamolson, 2007). The findings derived from this type of research may be generalised and applied to other contexts (Bryman, 2012).

4.3.2 The qualitative research approach

The qualitative approach to research involves an enquiry into the meanings that individuals or groups of people attribute to their actions (Creswell & Creswell, 2018). According to Denzin and Lincoln (2018) qualitative research "locates the observer in the world" (p. 43). The researcher gains a deeper understanding of how human beings behave in their natural setting (Guba & Lincoln, 1994). The researcher adopting a qualitative approach is concerned with interpreting how the participants view the phenomena under investigation (Bryman, 2012). Hence, this research strategy is often linked to the interpretive philosophy (Saunder et al., 2016). In contrast to quantitative research which is focused on numbers, qualitative research is focused on words (Bryman, 2012). Therefore the researcher has to adopt a particular research strategy which leads them to interact with the research participants to obtain a thorough understanding of the research issue (Creswell & Poth, 2018). Examples of research strategies in a qualitative approach include ethnographic research, narrative inquiry, case studies, action research and Grounded Theory (Saunders et al., 2016).

4.3.3 The mixed methods research approach

The mixed methods approach to research is a combination of a quantitative and a qualitative strategy to a study (Creswell & Creswell, 2018). The researcher may opt to apply a mixed method approach to the study to have a better understanding of the issue under investigation (Lodico et al., 2006). Kelle and Buchholtz (2015) list a number of examples that highlight the advantages of applying a mixed methods approach to a research study. These include:

- a quantitative study can help to corroborate findings from a qualitative study and to transfer these findings to other domains,

- results from the qualitative part of a mixed methods design can help to understand previously incomprehensible statistical findings,
- qualitative research can help to discover a lack of validity of quantitative measurement operations and instruments. (Kelle & Buchholtz, 2015, p. 353)

Thus, for example, in a mixed methods approach the researcher may conduct a number of interviews (qualitative) to discuss data gathered from a questionnaire (quantitative) to further explore the issue under study (Bryman, 2012).

4.3.4 My research approach

Scott (1996) maintains that to develop an understanding in education one has to consider the point of view of the social actors involved. In this sense, the researcher conducting research in the educational field needs to acquire knowledge from the people involved in education including students, teachers and school leaders. Since I wanted to investigate how the KGEs integrated mathematical learning opportunities into the emergent curriculum approach, I chose to conduct my study in a school. After I had explored the three different methodologies, I came to the conclusion that the best approach to conduct my research was by adopting a qualitative methodology within the interpretive paradigm. Mertens (2014) highlights that a qualitative approach to research provides "an in-depth description of a specific program, practice, or setting" (p. 296). I wanted to obtain detailed information directly from the people involved in the research and to observe their practice. Thus I could not apply a quantitative strategy to my research since my focus was obtaining the research participants' subjective view. Rather, since the main focus of my research involved the KGEs' classroom practices, applying a qualitative approach to my study seemed to be the most relevant.

Once I had established the research methodology I needed to choose the most suitable strategy to conduct my research. After reviewing the different research strategies within the qualitative research approach I concluded that the nature of the research called for a collaborative action research strategy.

4.4 Action Research

The purpose of action research is to explore strategies that can bring about change in practice (McNiff & Whitehead, 2009). The concept of action research originated from the work of Kurt Lewin (1946) who demonstrated how action research can be applied to develop group relationships, enhancing cooperation and communication (Adelman, 1993). He postulated that research for social practice needs to be embedded in action and described it as "a comparative research on the conditions and effects of various forms of social action and research leading to social action" (Lewin, 1946, p. 35). Although Lewin did not refer to education when he discussed action research, in the 1970's, the British educational thinker Lawrence Stenhouse applied this research approach to education (Atkins & Wallace, 2012). Stenhouse (2011) argued that research in schools is to be guided by action "in collaboration by professional researchers and professional teachers, is always provisional, […] and always to be tested and modified by professional practice" (p. 133).

This corresponds to Stringer's (2013) assertion that action research is a collaborative, systematic, cyclical approach which leads practitioners to inquire into their practice to devise strategies for improvement. Action research differs from what McNiff and Whitehead (2009) call *traditional* research as it is conducted from an insider perspective putting the practitioner in a position of control "as an active change agent" (Bryant, 1996, p. 108). The practitioners

engage in an ongoing process of observing, reflecting, acting and evaluating to bring about sustainable improvements to their practice (McNiff, 2016). During this process, the practitioners generate knowledge through a collaborative process (McNiff & Whitehead, 2006). Manesi and Betsi (2013) sustain that through collaboration the practitioners share ideas, experiences, knowledge and thoughts thus engaging in a community of practice.

The notion of a community of practice was introduced by Lave and Wenger (1991) who put forward the idea of learning in a social context. They proposed that "rather than learning by replicating the performance of others or by acquiring knowledge transmitted in instruction, we suggest that learning occurs through centripetal participation in the learning curriculum of the ambient community" (Lave & Wenger, 1991, p. 100). The community of practice creates a context where practitioners engage in action, sharing knowledge and understanding (Olanoff et al., 2021) which, according to Wenger (1998), "holds the key to real transformation – the kind that has real effects on people's lives" (p. 85). Furthermore, Wenger (1998) draws attention to the role of *leaders* in a community of practice as they can act as instruments to empower practitioners to take transformative action.

In my study I drew on Lave and Wenger's (1991) idea of a community of practice since I was researching a school wherein I was a member of the Senior Leadership Team (SLT). My aim was to work in collaboration with four KGEs of the same school. By engaging in my own community of practice through a collaborative action research approach, I wished to share knowledge, thoughts and experiences that lead to action, reflection and transformation. I also wanted to empower the KGEs to become active agents in their practice. Fisher and Wood (2012), sustain that the process of "collaborative enquiry-oriented research projects between

teachers and teacher educators/researchers" (p. 115) have the potential to bring *sustainable changes* to the teachers' practice. Therefore I devised a plan to carry out the research based on McNiff and Whitehead's (2006) action research strategy. This strategy includes the following steps:

- take stock of what is going on
- identify a concern
- think of a possible way forward
- try it out
- monitor the action by gathering data to show what is happening
- evaluate progress by establishing procedures for making judgement about what is happening
- test the validity of accounts of learning
- modify practice in the light of evaluation. (McNiff & Whitehead, 2006, p. 8-9)

After outlining the plan, I needed to choose the appropriate methods that would translate this plan into practice.

The methods chosen for research study should produce data which address and resolve the concerns highlighted in the research questions (Atkins & Wallace, 2012). Furthermore, the methods applied should also reflect the researcher's philosophical assumptions (Waring, 2017) and since I adopted an interpretive stance, I needed to employ methods which explore the participant's perspective on the topic of investigation. In addition, Stringer (2013) emphasises the importance of the methods employed in an action research producing evidence which is valid and reliable.

The concepts of the validity and reliability of a research originated in association with quantitative research and have been interpreted for qualitative research (Bryman, 2012). For example, Lincoln and Guba (1985) propose the alternative concept of trustworthiness in order for the researcher to "persuade his or her audience that the findings of an inquiry are worth paying attention to, worth taking account of" (p. 290). The authors developed the concept of trustworthiness into four criteria:

- *Credibility* refers to how complete and accurate the research findings are. This criterion can be addressed by applying a number of techniques including *prolonged engagement*, *persistent observation* and using a *triangulation* of methods to collect the data (Lincoln & Guba, 1985).
- *Transferability* is the degree to which the findings of the study can be applied to other settings (Roller & Lavrakas, 2015). According to Lincoln and Guba (1985) to enable transferability it is essential to provide a "thick description" (p. 214) in the writing of the findings.
- *Dependability* establishes how consistent the research findings are with the raw data collected. Dependability can be achieved by providing an audit trail of the research process (Roller & Lavarkas, 2015).
- *Confirmability* establishes "that data and interpretations of the findings are not figments of the inquirer's imagination, but are clearly derived from the data" (Tobin & Begley, 2004, p. 392). According to Roller and Lavarkas (2015) the dependability audit trail can be used to check for confirmability as it provides an account of all the steps taken during the process.

When writing about the validity and reliability of action research, Creswell and Poth (2018) draw on Lincoln and Guba's (1985) criteria of trustworthiness and propose a number of strategies. These include:

- applying a triangulation of methods,
- conducting regular observations in the field to build a good relationship with the participant to learn about their culture and context,
- collaborating with participants,
- providing a detailed description of the evidence collected (Creswell & Poth, 2018).

I drew on Creswell and Poth's (2018) strategies to choose the methods to collect the data in order to ensure the validity and reliability of my research outcome as I will explain hereon.

According to Stringer (2013), applying a triangulation of methods to a study implies that the researcher uses more than one approach to collect the data making the results more credible. To this end, the methods I employed were, focus group discussions, stimulated recall interviews and classroom observations to understand the KGEs perspectives and practices.

This research unfolded within a community of practice which means that the participants and I - as the researcher - worked in collaboration with each other. This helped me to build a sound relationship with the participants which was key to gaining their trust (Bryman, 2012). Stringer (2008) maintains that the researcher needs to develop a close relationship with the participants to obtain "insider knowledge" (p. 52), resulting in valid findings. Furthermore, since the Head of School is an integral part of our community of practice, I wanted to involve them in the study. Therefore, I chose to conduct two interviews with the Head of School (HoS) to gain an insight into their perceptions about the study and the relevance of the study to the

school. In addition, the data from the interviews were used to corroborate findings with the other data sources to make the results more valid and reliable (Schwatrz-Shea, 2006).

To ensure that I do not miss out on any information, I documented the process by audio recording the sessions and transcribing them in addition to taking notes. This helped me to provide a detailed description of the study. As Creswell and Creswell (2018) state, "[w]hen qualitative researchers provide detailed descriptions of the setting, for example, or offer many perspectives about a theme, the results become more realistic and richer. This procedure can add to the validity of the findings" (p. 274).

In the following sections I will give a brief description of the participants involved in the study and I will also explain how I applied each method of data collection in my collaborative action research.

4.4.1 The participants

The study was carried out in a Maltese Primary state school with a population of 482 children. The action research was carried out with all the four KGII educators working in the school. Each KGE was responsible for 14, four to five years old boys and girls. So as to ensure the KGEs' anonymity, I used the fictitious names of Anna, Joyce, Ruth and May in my writing. At the time of the study, Joyce had been a KGE for 32 years, Anna for 30 years, May for 11 years and Ruth for 7 years. The KGEs participated in three focus group discussions, three classroom observations and three stimulated recall interviews.

4.4.2 Focus group discussions

According to Hennink (2014), focus group discussions involve "a *focus* on specific issues, with a predetermined *group* of people, participating in an interactive *discussion*" (p. 1 (italics original)). The discussion is guided by a facilitator or moderator whose role is to lead the session, ensuring all participants are involved (Greenbaum, 2000). What distinguishes a focus group discussion from any other form of data collection method is that it draws on the respondents' interactions and construction of meaning (Bryman, 2012). The interaction among the group helps the researcher to gain a deeper insight into the participants' subjective view of the world and their beliefs and values about the topic under investigation (Gibbs, 1997). Stringer (2008) sustains that group participants are more likely to broaden their understanding of the issue being explored when interacting in a group rather than on an individual level. This is because as the discussion evolves, the participants are likely to share their views and experiences, question each other's views and develop new ideas on the subject (Hennink, 2014). Thus, I chose to conduct focus group discussions in my study since I was interested in how the interaction within the group helped the KGEs to understand and interpret the issue under study. The discussions, each of approximately 1 hour duration, took place at school at a time which was convenient for the KGEs.

Mertens (2014) sustains that the discussion during a focus group should be led by the facilitator, using a number of questions to steer the discussion to the important issues that should be covered. Thus, I prepared a set of questions for each of the three focus groups (see Appendix 1). During the first focus group discussion, drawing on the first two steps of McNiff and Whitehead's (2006) plan, I wanted to discover the KGEs perspectives on the introduction of the emergent curriculum approach. During the discussion we also explored the

mathematics learning outcomes mentioned or implied in the LOF (Levels 1-3). I was interested in discovering how the mathematics learning outcomes were being translated into learning opportunities in the KGEs' project plans and the KGEs' concerns in this regard.

During the second focus group, we discussed the way forward. Together we planned mathematics learning opportunities that each KGE would be developing with her students and the implementation of the learning opportunities in the classroom. The KGEs had the opportunity to share and develop ideas together despite the fact that they had different projects going on.

The third focus group discussion took place after I had carried out all the classroom observations and stimulated recall interviews. During the final discussion we evaluated the outcomes of the implementation including the children's apparent engagement. The KGEs identified the challenges encountered and considered different approaches to the teaching of mathematical concepts and processes in kindergarten classrooms. The discussion also focused on the collaborative process of the research and its effect on the KGEs' professional development.

During all three focus groups, I recorded the discussions and took notes, as I was aware that it would be difficult to write down everything that was being said during the sessions. Bryman (2012) highlights that during these type of discussions it is important to capture the "nuances of language" (p. 504) which would be lost if the researcher had to rely only on notes written during the sessions. In addition, recording the discussions helped me to keep focused on the conversation.

4.4.3 Classroom observations

The aim of carrying out observations is to obtain information about what actually takes place during the event or activity under study, rather than relying only on accounts of the participants (Stringer, 2008). Saunders et al. (2016) make a distinction between four types of observation roles that the researcher may take. These are:

- Complete participant: where the researcher conceals their identity and takes part in the activity.
- Complete observer: where the researcher reveals their identity and observes from a distance without participating in the activity.
- Observer as participant: which gives the researcher the opportunity to interact in some instances of the activity while still maintaining the observer role.
- Participant as observer: which allows the researcher to take both the role of the observer while participating fully in the activity (Saunders et al., 2016).

After some consideration, I decide that I would take the role of *observer as participant* since although my aim was to observe how the KGEs developed the mathematics learning opportunities, I also wanted to interact with them and the children to understand to what extent the children internalise the mathematical concepts and processes.

This was the phase where I carried out the next two steps in McNiff and Whitehead's (2006) plan, that is, *try it out* and *monitor the action by gathering data to show what is happening.* I observed three classroom activities per KGE, of approximately 45 minutes each. The observations were planned to be carried out over a period of 3 weeks, one observation per KGE, per week. However, after the first round of classroom observations, due to the COVID-

19 pandemic, the observations had to be postponed since schools were closed for 1 week followed by another 2 weeks of Easter holidays. Observations resumed after the break. Thus, classroom observations were carried out over a period of 6 weeks. During the observations I wanted to discover how the KGEs developed the activities to incorporate mathematics in their projects, and the practices they employed, including scaffolding strategies and the resources used. I was also interested to observe the impact of the activities on the children's mathematical learning. So that I would not miss out on any important details, I audio recorded the sessions. I also took field notes, using a classroom observation recording sheet to guide me (see Appendix 2), and took photos of the children's work. After each observation, I listened to the audio recording and amended my field notes as necessary so that I would have a detailed description of what actually happened during the activity.

4.4.4 Stimulated recall interviews

According to Gass and Mackey (2017) stimulated recall interviews (SRIs) "are used primarily in an attempt to explore learners' thought processes and/or strategies, by asking learners to reflect on their thoughts after they have carried out a pre-determined activity" (p. 44). Furthermore, as Shubert and Meredith (2015) outline, SRIs allow the researcher to gain insight into the participants' thoughts that may not be "readily apparent through direct observation" (p. 4). In my study, drawing on McNiff and Whitehead's (2006) last three steps of the action research strategy, I carried out SRIs with each KGE to assist them to reflect on and evaluate the classroom activities. Furthermore, the SRIs helped the KGEs to assess how the activity impacted the children's learning and plan any modifications needed for future activities, based on the evaluation. Gass and Mackey (2017) maintain that it is important that the duration of

time between the activity and the SRI is kept short so that it will easier for the participants to recall information. Therefore, following each classroom observation, I conducted an SRI with each KGE in which I used a number of guiding questions, as stimuli, to help the KGEs recall the activity and reflect on it (see Appendix 3). In addition, my contribution in the SRIs provided the KGEs with feedback on the activity. As Darling-Hammond (2013) sustains, immediate feedback following a performance helps teachers to reflect on their performance thus leading to practice improvement. Furthermore, the SRIs helped me to obtain the KGEs' interpretations of the activities, thus allowing me to corroborate the evidence I collected from the observations which according to Shubert and Meredith (2015) make the findings more valid.

4.4.5 Semi-structured interviews

Interviews are described by Stringer (2013) as informal conversations where interviewees can relate their views on the issue investigated. Bryman (2012) distinguishes between three types of interviews: structured, unstructured and semi-structured. *Structured interviews* are applied to gather quantitative data and the researcher's interaction with the interviewee is minimal (Saunder et al., 2016). The interviewer poses a number of set questions with a range of fixed answers (Bryman, 2012). In contrast, in the *unstructured* approach, the researcher may use just one question at the start of the interview to set the conversation going and then follow up any point relevant to the study (Stringer, 2013). *Semi-structured* interviews are based on a set of questions which can be amended as the interview unfolds (Saunders et al., 2016). The advantage of conducting *semi-structured interviews* over other methods of data

collection is that the researcher can prompt the interviewee to further develop the argument thus obtaining richer data (McNiff, 2016).

For the purpose of my study I opted to conduct two semi-structured interviews with the HoS. I envisaged that the study would leave an impact on the KGEs and the school and to this end I believed that the participation of the HoS would bring valuable knowledge to the study. However, at the time I was to conduct the first interview, the HoS was not in a position to take part in the interview. After I consulted my supervisor on the matter, it was decided that I conduct the interviews with an Assistant Head of School instead. Permission was granted and therefore I could continue my research process.

During the first interview with the Assistant Head of School we discussed the emergent curriculum approach in general, the mathematics learning outcomes for Levels 1-3, the collaborative approach of my research and the relevance of my research to the school. Through a second interview, which was held after I carried out the classroom observations, I discussed the outcomes of the research and if, and how, they could be translated into an action plan as part of the school development programme. I prepared a set of questions for each interview (see Appendix 4), that served as guidelines and probed further where necessary (Lodico et al., 2006). I audio recorded the interviews and also took notes during the interviews as this approach allowed me a more thorough examination of the respondent's answers (Bryman, 2012).

4.5 Ethical Considerations

Before starting my research I sought ethical clearance from the Faculty Research Ethics Committee at the University of Malta (FREC) (see Appendix 5). According to Shenton and Hayter (2004), the first step when conducting qualitative research is to obtain the permission of all gatekeepers to approach potential participants. Since my research was based in a state school, I obtained Institutional permission from the Directorate for Research, Lifelong Learning and Employability within the Directorate of Education (see Appendix 6). Locally, state primary schools and secondary schools are grouped into ten regional Colleges (Bezzina, 2019). Hence, I also needed to present the Head of the College with a permission request to conduct the study in the chosen school (see Appendix 7). Once permission was granted, I approached the HoS to request permission to carry out the research in the school (see Appendix 8), to which the HoS consented. Having collected all permissions, FREC granted approval for the study to commence.

The next step was to obtain the consent of the participants. I provided the HoS with an information letter and a consent form relating to the interviews (see Appendix 9a). The information letter included an invitation to participate in two semi-structured interviews to discuss the participant's views on the project approach, the learning outcomes and the relevance of my research to the school. In addition, I asked the HoS to act as an intermediary to invite the KGEs to participate in the study. I also stated that participation is voluntary and that I will use pseudonyms in my write-up to ensure confidentiality. The HoS consented to participate in the interviews, however, as stated in Section 4.4.5, when it was time to conduct the interview, the HoS was not in a position to participate in the study. After obtaining

permission from FREC, I invited one of the other two Assistant Heads to participate in the study through an information letter and they consented to participate in the study by filling the consent form (see Appendix 9b).

During the research I was aware of my dual role, that of a researcher and of a member of the SLT. Therefore, I needed to reflect carefully on how to mitigate against any conflicts as I did not want the KGEs to feel threatened or to embark on the research against their will. For this reason, as previously stated, I asked the HoS to act as intermediary to invite the 4 KGEII educators at our school to participate in the research and present them with an information letter (see Appendix 10a). It is important to ensure that research participants "enter research projects voluntarily, understanding the nature of the study […] and obligations that are involved" (Bogdan& Biklen, 2007, p. 48). Thus, in the information letter I stated the purpose of the study, which is, to devise a plan to integrate mathematical concepts and processes into the children's learning experiences. I also invited the KGEs to participate in 3 focus group discussions and 3 classroom observations. I also outlined that they have a right to withdraw from the study at any time and without any consequences and if they chose to participate I would keep their identity confidential and anonymised through the use of pseudonyms. All 4 KGEs showed an interest to participate in the study and gave their consent (see Consent Form in Appendix 10a). In addition, I must highlight that the decision to conduct the stimulated recall interviews was taken after the study had started. After obtaining permission from FREC to add this step to my study, I presented the KGEs with an information letter and they accepted to participate by signing a consent form (see Appendix 10b).

It was also important that during the process of the study the KGEs do not feel intimidated by my presence. Therefore, I chose to involve another Assistant Head of School to act as a critical friend. Evans (2015) describes the role of the critical friend as one built on a "relationship of trust and mutual respect" where the critical friend "joins with research and action partners to subject community practice to deliberate and continuing critique" (p. 356). I presented the Assistant Head with an information letter and consent form (see Appendix 11) inviting them to sit in during the focus group discussions, stimulated recall interviews and classroom observations to ensure that the participants did not feel pressured and that everything was running in an ethical way. The Assistant Head consented to act as a critical friend.

As the observations were conducted in the classrooms involving young children (aged 4 – 5 years), it was appropriate to obtain the parents' and subsequently the students' own consent for their participation in the study. The parents' information letters in both English and Maltese together with the consent forms in both languages were distributed by the KGEs who then returned the signed consent forms back to me (see Appendix 12). In the information letter I outlined the aim of the study and that I would be present during a number of the children's classroom activities and would take notes of the children's contributions. I also explained that I may need to take photos of the children's work and that the children's names would not be used in my writing. All parents consented to let their children participate in the study.

As highlighted by Gazelle et al. (2015) it is not always possible to gain written consent from children under five years. I therefore provided the KGEs with a brief description of the study in both Maltese and English (see Appendix 13a), to be read to the students in their respective

classrooms. After the KGEs' description, the children were given a paper depicting a smiling and a sad emoji (Appendix 13b). The children showed their assent or otherwise by drawing over the chosen emoji to reflect their choice. All the students in the 4 classrooms gave their assent to the study by drawing over the smiling emoji.

Since in my dissertation write-up I state my position in the school, I was aware that there may be a chance that the school would be identified. Lodico et al. (2006) argue that due to the amount of detailed information in a qualitative study, it is not always possible "to keep confidential the persons or school being studied" (p. 151). Therefore I informed the potential participants, including the parents, of this possibility in the information letters and also reiterated it in the consent forms.

In the data collection process I made use of audio recordings, transcripts and field notes. Saunders et al. (2016) sustain that the data compiled during the research should be destroyed after completion of the project to maintain the confidentiality and anonymity of the participants. Thus, in the information letter, I assured the participants that the data would be used solely for the purpose of the study, would not be shared with anyone else, and on completion of the research all data would be destroyed.

4.6 Timeline of the Study

The data was collected during scholastic year 2020 - 2021. At that time we were in the middle of the COVID-19 pandemic and schools had a health protocol to follow which included a number of measures. Being a member of the SLT at the school where I was going to conduct my research, I had the opportunity to discuss with the HoS the measures I had to take to

conform to the health protocol since the qualitative approach to collecting data involved interacting with the participants. Therefore, for the interviews and focus group discussions, a large room with enough space for everyone involved to keep a safe distance as established by the protocol, was identified. It was also agreed that the observations could go ahead since the classrooms were large enough for me to join in the activities while keeping a safe distance. Table 4.1 provides an account of the data collection timeline.

February 2021	1st Focus Group Discussion
February 2021	2nd Focus Group Discussion
March 2021	1st Interview with the Assistant Head of School
March – April 2021	3 Classroom Observations per KGE. Each observation was followed by a stimulated recall interview with each KGE.
April 2021	3rd Focus Group Discussion
May 2021	2nd Interview with the Assistant Head of School

Table 4.1 – Data Collection Timeline

4.7 Data Analysis

The aim of analysing data in action research is to understand the participants' perspectives, actions and behaviours (Stringer, 2008). Thus, the researcher needs to employ a rigorous and methodical approach to their analysis to produce a credible result (Nowell et al., 2017). Braun and Clarke (2012) recognise thematic analysis as a valuable method that can be applied in qualitative research including action research. The aim of thematic analysis is to look for patterns or themes across a data set (the methods employed to gather evidence) (Saunders et al., 2016). Braun and Clarke (2006) suggested a *six-phase* process which can be applied in a thematic analysis approach. This process includes the following steps:

I. Become familiar with all aspects of the data

II. Generate initial codes

III. Search for themes

IV. Review themes

V. Define and name themes

VI. Produce a report (Braun & Clarke, 2006).

Although the phases are numbered, Braun and Clarke (2006) highlight that the process should not be approached in a linear way but they recommend a reflective and iterative process.

During the analysis stage of my research I chose to adopt a thematic analysis approach drawing on Braun and Clarke's (2006) *six-phase* process. I started the process by immersing myself in the data by listening to the audio recordings of the data sets a number of times and subsequently transcribing them. I then read the transcripts while comparing them to the field notes, merging any relevant points from the field notes to the transcriptions. Following this, I read through the transcripts once again. Then, from the transcriptions, I identified initial codes which were related to the pre-determined themes outlined in my theoretical framework. These included Anghileri's (2006) levels of scaffolding strategies, Warford's (2011) 4 stages of ZPTD, Wood et al.,'s (1976) functions of scaffolding processes, the role of the MKO and the ZPD. However, as the process unfolded, other themes emerged which I deemed relevant to my research. Braun and Clarke (2012) maintain that at the coding stage, the researcher should code any potential data and use it or discard it at a later stage. The next step was to collate the relevant coded data into the pre-determined themes and other themes that emerged. Following this, I reviewed the themes looking for possibilities to merge themes or split themes into subthemes. I created a thematic map defining the main themes and discarded any themes which were not supported by enough data or that lost their relevance

in relation to the research questions. Table 4.2 illustrates, as an example, how codes identified from the focus group discussions, the stimulated recall interviews and the Assistant Head's interviews were merged into one theme.

Codes	Theme
• working with SLT • support from someone who is more knowledgeable • discussing together • sharing knowledge • mentoring	The Collaboration between the MKO and the KGEs (new emergent theme)
• familiar with Maths Learning Outcomes • reflecting on classroom practices • need to change practice • unsure of recommended practice • uncertainty • need of assistance	Self-Assistance (pre-determined theme)
• guidance by MKO • discussing recommended practice • assistance to address mathematics • assistance in planning • feedback on implementation of activities	Expert-Other Assistance (pre-determined theme)
• reflection on action • identify challenges • discuss challenges and way forward • encouragement and support • implementing recommended strategies in the 3rd activity	Internalisation and Recursion (pre-determined theme)

Table 4.2 – From Codes to Themes

The above-mentioned themes, that is: The *Collaboration between the MKO and the KGEs, Self-Assistance*, *Expert-Other Assistance* and *Internalisation and Recursion* were then merged into one Main theme, namely, *Kindergarten Educators' Professional Development* and subsequently considered as subthemes. The final stage in my analysis was to write a detailed report of the findings in which I addressed the research questions.

4.8 Conclusion

In this chapter I have outlined the plan for conducting my research. I highlighted my chosen research paradigm and methodological assumptions which informed my choice of methods. The ethical issues concerning the study were also discussed, providing details on how access was gained and consent from all the participants was obtained. In the next chapter I will discuss the analysis of the data which was explored through a thematic approach. This analysis will provide insight on how a collaborative action research approach between a member of the SLT and four KGEs led to integrating mathematical concepts and processes into children's learning experiences at KGII level.

Chapter 5 - Analysis of Data and Discussion

5.1 Introduction

In this chapter I will present the results of the thematic analysis of the data gathered from the focus group discussions, the stimulated recall interviews, the classroom observations, the field notes and the semi-structured interviews conducted with the Assistant Head of School. The analysis and discussion of the data address the research questions by way of pre-determined themes and other themes that emerged and in the light of reviewed academic literature. For ease of reference, each data set is given a code of reference. These codes are presented in Table 5.1.

Data Set	**Code of Reference**
Focus Group Discussion 1	FGD1
Focus Group Discussion 2	FGD2
Focus Group Discussion 3	FGD3
Classroom Observation	CO
Stimulated Recall Interview	SRI
Semi-structured interview with the Assistant Head of School	INT

Table 5.1 – Codes of Reference

Furthermore, as stated in the previous chapter, I will use pseudonyms so as to ensure the participants' anonymity. I will refer to the KGEs as May, Ruth, Anna and Joyce and to the Assistant Head of School as AH.

5.2 Overview of the Identified Themes

During the process of analysing my data I looked out for the pre-determined themes outlined in my theoretical framework. However other new themes emerged which were either

aligned to the theoretical framework or relevant to my research questions. In all, ten themes were identified which were categorised as three Main Themes. Table 5.2 illustrates the Main Themes and the related pre-determined and new emergent themes which I called Subthemes. The new emergent Subthemes are presented in bold type and marked with an asterisk.

Main Themes	Subthemes
1 **Kindergarten Educators' Professional Development**	• ***The collaboration between the MKO and the KGEs** • Self-assistance • Expert other assistance • Internalisation and recursion
2 **Supporting Children's Learning through Scaffolding Strategies**	• Environmental provision • Explaining, reviewing and restructuring • Developing conceptual thinking • ***Questioning strategies**
3 **Integrating Mathematical Content into the Project Approach**	• ***Teacher-led and child-initiated mathematical learning opportunities** • ***Assessment**

Table 5.2 – Main Themes and Subthemes

The first Main Theme is concerned with the KGEs' professional development, highlighting the process of how the MKO's role in a collaborative action research project, led to the KGEs' professional growth. This Main Theme includes three Subthemes generated from the pre-determined themes based on Warford's (2011) four stages of Zone of Proximal Teacher Development (ZPTD). I will explain how these stages, through scaffolding practices as

proposed by Wood et al. (1976) assisted the KGEs to develop professionally. In addition, a new emergent Subtheme, *The collaboration between the MKO and the KGEs*, was considered as falling under this Main Theme.

The second Main Theme addressed the development of children's mathematical learning through the support of scaffolding strategies applied by the KGEs. This Main Theme was developed into pre-determined Subthemes based on Anghileri's (2006) three levels of scaffolding strategies which include *environmental provision, explaining, reviewing and restructuring* and *developing conceptual thinking*. The analysis will highlight how the KGEs assisted the children to move within their zone of proximal development applying the mentioned scaffolding strategies. Furthermore, a scaffolding strategy that emerged from my findings and which I included under this Main Theme was that of the *questioning strategies* used by the KGEs with their students to develop their learning.

The third Main Theme that evolved concerned the pedagogy applied by the KGEs to integrate mathematical concepts and processes mentioned or implied in the LOF, with the project approach. This theme includes Subthemes that emerged from the data, namely, *teacher-led and child-initiated activities* and the *assessment* practices employed by the KGEs.

In the following sections I will give a detailed description of the findings related to the identified themes. In order to validate my interpretation of the findings I will present direct quotes derived from the transcriptions of the audio recordings. As Braun and Clarke (2006) sustain, embedding raw data within the analysis "tells[s] the complex story of your data, in a way which convinces the reader of the merit and validity of your analysis" (p. 93). Since, my

writing is in English, and during the FGD, SRI and activities the KGEs and the children used a mix of both Maltese and English, I have translated as faithfully as possible any phrases from the transcripts which were originally stated in Maltese. These phrases will be presented in a bold type.

5.3 Main Theme 1: Kindergarten Educators' Professional Development

The study involved a collaborative process between myself as a researcher and four KGEs from the same school where I am a member of the Senior Leadership Team (SLT). The study was designed to create a context within this community of practice where my role as a leader/researcher would empower the KGEs to share expertise and engage in action to reflect on their practice. Wenger (1998) holds that communities of practice are key to foster interpersonal relationships, allowing practitioners to share their knowledge, negotiate meaning and participate in action. The collaborative approach to the research allowed me to facilitate the process for the KGEs to plan-act-evaluate and, where necessary, modify their practice thus leading them to professional growth. I chose a collaborative stance as through my research I drew on Vygotsky's (1978) concept of ZPD which holds that learner development is attainable in collaboration with more knowledgeable others. As outlined in Chapter 3, my teaching experience and the knowledge I acquired from academic literature and professional development sessions put me in the position of the MKO which allowed me to collaborate with the KGEs and hence share my expertise with them.

5.3.1 The collaboration between the MKO and the KGEs

When I analysed the data from FGD3 and the INTs, the importance of the collaborative approach emerged significantly. All KGE participants agreed that, notwithstanding the fact

that they often discussed strategies and classroom experiences among themselves, the collaborative approach was more effective. They highlighted that the collaboration with a MKO, who also happened to be a member of the SLT in their school, provided sustainable support. Ruth remarked that:

> This is something missing in our practice. It is nice to be able to discuss strategies and experiences in a group and [to have] someone who knows you, has knowledge and can guide you.

The AH also acknowledged the benefits of a collaborative approach between a member of the SLT and the KGEs, highlighting that it is the ideal situation. The AH maintained that this approach allows for discussion and negotiation which is important in a school community. Wenger (1998) holds that negotiation between members of a community is crucial in order for participants to feel that their contribution is valued. He further claims that negotiating meanings in a community "offers an ideal context for developing new understandings because the community sustains change as part of an identity of participation" (Wenger, 1998, p. 215). This in fact resonates with the KGEs responses as they remarked that the discussions led them to adopt a change in their practice. Anna claimed that:

> The fact that we discussed together brought a change in the way I now create the learning opportunities for the children and I intend to continue this way.

Anna, who had been teaching for 30 years, claimed that after many years implementing a thematic approach, she was faced with the drastic change of implementing an emergent curriculum approach. The thematic approach Anna was referring to is a way of teaching and learning where the teachers select a theme and plan activities connecting all learning areas to the theme. Anna stated that the training that KGEs were offered by the Education authorities to implement the change in their practice was, in her opinion, not enough. Teachers needed more guidance. Anna claimed that working in collaboration with her colleagues and a MKO

was beneficial to embrace the change and transform her practice. On the same lines, Joyce, who was also a veteran in her job, highlighted that to implement the change in their practice they needed more training and she sustained that the collaboration with a MKO:

> [It] was like having a mentor, who discusses with you, observes and helps you reflect.

Similarly, the AH also highlighted that collaborating with a MKO was like:

> Having a mentor who guided them throughout the process and helped them if they had doubts, uncertainties and difficulties. You encouraged them to go on, so they wouldn't feel overwhelmed.

This made me realise that my role as the MKO also put me in a position of a mentor who guided and supported the KGEs in their professional growth. As Callan (2006) outlines, mentoring is a process by which the mentor transmits knowledge and skills, links theory with practice, promotes good practice, focuses on the potential of the practitioners and enhances the professional growth of practitioners. Through this collaborative process I sought to create a relationship of trust, where I shared my knowledge with the KGEs, guiding them in an action-reflection process. This was evident from the responses of the four KGEs who indicated that the discussions and interviews helped them to reflect on their practice and this, in turn, brought about a change in the way they developed learning opportunities and integrated mathematical content. Thus, they reported a development in their learning, and drawing on Vygotsky (1978), I can say that they moved ahead within their ZPD. As explained in the theoretical framework presented in Chapter 3, Warford (2011) applied the Vygotskian notion of ZPD to teacher education and proposed stages of *ZPTD*. In the following sections I will discuss, based on my findings, the process of how the KGEs moved ahead within their *ZPTD*.

5.3.2 Self-assistance

Warford (2011) emphasises that due to the weight of the teachers' prior classroom experiences, the first stage of the ZPTD should be that of self-assistance. During this stage, the focus is on the teachers' actual level of development as they engage in a reflective process about their classroom practices, beliefs and assumptions (Fani & Ghaemi, 2011). During FGD1, I facilitated the KGEs self-assistance stage by drawing on Wood et al.'s (1976) first function of scaffolding practices, *Recruitment*. Wood et al. (1976) describe *recruitment* as a scaffolding strategy used to enlist the interest of the participants. I therefore sought to first direct the discussion to generate an interest within the group on the mathematical learning outcomes mentioned or implied in the LOF at Levels 1-3. I then asked guiding questions to lead them to reflect on their practice especially with regard to how they address mathematics content in the classroom activities within the emergent curriculum approach.

All KGEs showed interest in discussing the learning outcomes (Level 1-3) and they were all familiar with the document. The KGEs had no problem identifying the mathematical learning outcomes mentioned or implied at Levels 1–3, even though there was no reference to mathematics as a subject learning area. When it came to reflecting on their classroom practices, especially with regard to how they incorporate mathematics learning within the project, the responses of the KGEs were as follows:

> Anna: Before the emergent curriculum it was very simple. We used to use the *Abacus* textbook and everything was structured and straightforward. We were sure outcomes were targeted. **Now, to make sure an outcome is covered, I do maths as an activity on its own. I know it should be integrated into the project but I still do it the old way.**

Ruth: I find activities targeting Maths like, for example, when the project was about fish, the maths activity was a fishing game with numbers. However I am aware that it is all teacher-led.

May: **I do the same but I know it is not the correct way to do things [like this] in an emergent curriculum approach.**

Joyce: **Twice a week I present a maths activity to the children, targeting an LO. I feel that if I do not do it this way children will not learn. How are they going to know the value of a number if they have never learnt it? I am still not sure how to do things the right way, with the emergent approach.**

These findings imply that the discussion led the KGEs to reflect on their practice and become aware that their teaching strategies were not conforming to the emergent curriculum approach. In addition, the data also indicated that the KGEs were uncertain on how to apply the correct pedagogical practices.

At this stage I applied the second scaffolding strategy as proposed by Wood et al. (1976), *Reduction in degrees of freedom,* which implies that the tutor simplifies the task. I 'simplified' the task in the sense that I channelled the KGEs attention towards the ideal pedagogical practices outlined during the training sessions organised by the Education authorities addressing the emergent curriculum approach. I felt that this scaffolding strategy was necessary, as, although the KGEs had attended the training sessions, it seemed that it was not enough to leave an impact on their practice. Data from the INTs revealed that the AH felt that the emergent curriculum approach was proving to be quite challenging for the KGEs and more training and assistance was needed for its correct implementation. Since I had attended the same training as the KGEs, I felt I was in a position to guide them in the recommended direction. The data revealed that the discussion helped the KGEs to draw on the ideal

practices outlined during the training sessions and become aware that to achieve these ideal practices they had to change their practice. For example May stated that:

> We need to change our planning. It seems like we are doing a thematic approach rather than a project approach.

The fact that the KGEs themselves recognised that they needed to change their practice was pivotal to the study. This is because, as outlined by McNiff and Whitehead (2006), action research is successful when through reflection, practitioners themselves identify a problem and take action to improve their practice. Furthermore, as explained by Warford (2011), when through self-assistance, teachers themselves recognise the need to change their practice, they welcome the help of an expert 'other' to move forward in their professional development.

5.3.3 Expert other assistance

When speaking of child development, Vygotsky (1987) theorised that "with collaboration, direction, or some kind of help the child can always do more than he can independently" (p. 209). Warford (2011) applied this theory of development to teacher education and proposed the intervention of an expert other to assist teachers in their ZPTD. The analysis of the data from FGD2 showed how the MKO applied the scaffolding strategy *Direction Maintenance* (Wood et al., 1976) to lead the KGEs to amend their practice. The data revealed that the MKO made reference to the points which emerged during FGD1, to guide the KGEs to create learning opportunities where mathematical learning can be developed from the project. The learning opportunities discussed were based on play activities as "the influence of play on a child's development is enormous" (Vygotsky, 1978, p. 96). Furthermore, the KGEs were encouraged to develop learning opportunities through guided-play activities as guided play offers the possibility for children to be free to explore and construct knowledge and at the

same time participate in "orchestrated mathematical learning activities" (Breive et al., 2018, p. 184). I must highlight that the learning opportunities for the classroom activities were developed as part of the KGEs ongoing projects. But while for Joyce and May the topic of the projects remained the same throughout the three activities, that is, *Rockets* and *Cars* respectively, Anna's first two activities focused on *The weather* and the third activity focused on *Bears* while Ruth's first two activities related to the project *Dinosaurs* and a new project *The Farm* was explored during the third activity. Excerpts from the activities will be discussed in the Second and Third Main themes.

During FGD2, the KGEs put forward their ideas on different learning opportunities that could be created and they were open to change their approach. May remarked that:

> The project derived from the children's interest is [about] cars. The activities I had in mind were mostly teacher-led. [For example] giving them car tyres to draw circles to target shapes. Now I need to revisit my ideas and let the children investigate and see what they come up with.

Ruth explained that her ongoing project was about dinosaurs and she was now aware that she needed to let the children explore more and at the same time use guiding questions to elicit mathematical content. Joyce, who at the time was working on the project *Rockets,* and was focusing on targeting numbers from 1 to 10, was also keen to amend her practice. She stated that:

> Usually I would have given them the numbers from 1 to 10 and ask them to put them in order. Now I think I will use a foil tray and put some numbers in it with other things related to rockets, like pebbles which resemble rocks on the moon. We will see what they come up with. Maybe the concept of sequencing and patterns would emerge.

Anna, whose project was about the weather stated that:

> **I already had an idea of giving the children big and small clouds and asking them which cloud is big and which is small. Now I know that I have to let them create their own clouds and observe where it leads the children.**

The above responses imply that with the help of the MKO, the KGEs were working towards amending their practice thus moving forward in their ZPTD. Since the KGEs were asked to plan three classroom activities, it was agreed that stimulated recall interviews would follow each activity so that the KGEs could evaluate and reflect on their performance, and with the MKO's assistance, discuss the planning of the following activity.

5.3.4 Internalisation and recursion

Internalisation and *recursion* are the advanced stages in Warford's (2011) ZPTD. Warford (2011) explains that teacher development "progresses towards internalisation and repeated application of the pedagogical concepts [the teachers] have learned" (p. 255). According to Vygotsky (1981), internalisation occurs when what was learnt on '*the social plane'* is transformed into *'the psychological plane*'. This implies that the individual constructs new knowledge which is derived from experiences shared with others (Bartolini Bussi & Mariotti, 2008). Applying this to my research context, I considered that the KGEs would progress in their development when they would have internalised the new pedagogical knowledge acquired and applied this knowledge repeatedly in the classroom. Warford (2011) presented stages of internalisation and recursion and refers to one stage following the other. However, as this study was based on an action research project where the KGEs plan-act-reflect and act again, the process of internalisation and recursion were intertwined.

The data from the first SRIs showed how the MKO applied Wood et al.'s (1976) scaffolding strategy, *Marking Critical Features* to assist the KGEs to progress towards the internalisation stage. This scaffolding strategy helped the KGEs to reflect on the activity and recognise any discrepancies between the way they delivered the activity and the ideal practice that should

be employed in an emergent curriculum approach. The way the SRIs were conducted, that is, individual SRI after each classroom observation, also served to scaffold the KGEs development from one session to the next. During the first SRI, all KGEs were satisfied that they now feel more confident to incorporate mathematical learning opportunities into the project. However, all KGEs showed concern regarding the extent to which they allowed the children to take the lead during the activities. May was aware that although she attempted to let the children explore more, she ended up taking over the activity which left little space for the children to investigate. Similar remarks were made by the other three KGEs such as:

> Joyce: I felt that if I left them to continue playing with the foil tray they would not do anything related to Maths. I had to tell them what to do. But I know I need to be more oriented towards child-initiated activities.
>
> Ruth: My activity was more teacher-led. I ask them to do this and do that! It's not easy to lead children to a mathematical concept with a child-initiated activity.
>
> Anna: I know that we are supposed to let children investigate. The activity was teacher-led. I am confused. I feel anxious about the next activity.

The above responses indicate that although the KGEs had made some "progress towards internalisation" (Warford, 2011, p. 255) in the sense that they integrated mathematics into the project, they still needed assistance to implement the emergent curriculum pedagogical practices. According to Stacey (2009), in an emergent curriculum approach "the teacher takes on the role of facilitator, taking what she sees and hears, and bringing to children the opportunity to discover more, dig deeper, and construct further knowledge" (p. 5). The findings from the first SRI indicate that the KGEs were aware of the practices that should be employed in an emergent curriculum approach but were still finding it challenging to apply them. Thus, they needed more support and encouragement which the MKO applied through the scaffolding strategy, *Frustration Control.* Wood et al. (1976) explain that this scaffolding

strategy is used to support the learner to solve the problem. The MKO sought to offer support by discussing the following activity with each KGE, assisting them to plan learning opportunities which allowed children to investigate more while teachers applied guided assistance.

Following the second classroom activity, the second round of SRIs took place. As in the first SRIs, the MKO applied Wood et al.'s (1976) scaffolding strategy, *Marking Critical Features.* The data showed that during the classroom activities the KGEs had, in fact, sought to create mathematical learning opportunities where the children were allowed time to explore and investigate. This implies that they were beginning to embrace the new pedagogical practices, and thus progressing in their development. All KGEs were very positive about the outcome of the second activity. Joyce stated that:

> I feel this activity had a better outcome than the first one. I allowed time for the children to explore and some of them even created patterns and started counting while at the same time I guided them and prompted.

May was very enthusiastic about the outcome of the activity and said that:

> Doing things the old way, I underestimated the children's ability to think. Now I realise that they are capable of accomplishing things on their own. Obviously they need guidance.

Anna who showed anxiety during the first SRI was more at ease and she remarked that:

> **The outcome is much better this time round. The session [with you] following the activity is useful as it helped me to reflect and evaluate and helped me improve. I was pleased to see children explore and discuss with each other. I already have an idea of what to do for the next activity.**

Ruth was also pleased with the outcome of the activity and with the fact that she created more child-initiated learning opportunities. She highlighted that:

> **My planning now is focused more on child-initiated learning opportunities. I still feel that I need to guide them to engage them in tasks which are maths related but the**

children seem to enjoy the activity more as they have more time to investigate while playing.

These findings indicate that the KGEs had moved forward in their ZPTD as they adopted new strategies to create learning opportunities that allow children to investigate and inquire to construct new knowledge. During these SRIs, the third activity was discussed. However, in contrast to the first SRIs, the MKO did not need to apply the scaffolding strategy *Frustration Control* as the KGEs were able to plan the third activity with little support from the MKO. The data from the third round of classroom activities showed evidence that the KGEs were moving forward in their development as they sought to create learning opportunities where children were allowed time to inquire and explore. Furthermore, by listening to and observing the children's talk and actions the KGEs seized opportunities to address mathematical content and processes, thus helping children move forward in their learning. In the next section I will analyse in what ways the KGEs transferred their development to enhance the children's mathematical learning through scaffolding practices.

5.4 Main Theme 2: Supporting Children's Learning through Scaffolding Strategies

As outlined in Section 3.5, during the classroom observations I sought to identify the classroom practices applied by the KGEs to move children forward in what Vygotsky (1978) termed the ZPD. I was interested to observe how the KGEs assisted each child "to move beyond the level she displays in the classroom or setting to a higher level of functioning" (Smidt, 2009). Drawing on Wood et al. (1976), Anghileri (2006) proposes a number of scaffolding strategies that can be applied by the teacher to assist children to develop their mathematical understanding. Thus, while analysing the data from the COs, I drew on

Anghileri's (2006) hierarchy of scaffolding strategies to look for scaffolding practices applied by the KGEs to develop the children's mathematical thinking. Furthermore, the theme of *questioning strategies* applied by the KGEs to scaffold children's learning emerged. In the following sections I will explain the findings from the data.

5.4.1 Environmental provision

Environmental provision is the most basic level in Anghileri's (2006) three-level scaffolding model. Anghileri (2006) explains that the scaffolding strategy *environmental provision* "enable[s] learning to take place without the direct intervention of the teacher" (p. 38). Such *environmental provision* include sequencing and pacing events, classroom organisation including wall displays, artefacts and children's grouping, free play, self-correcting tasks and emotive feedback. Data from the INTs revealed that the AH also believed that the environment plays an important role in the children's learning. They maintained that provision such as the physical environment, the grouping of children and resources can have a positive effect on children's learning.

Anghileri (2006) sustains that although the sequencing and pacing of tasks may not be considered as a scaffolding, the way the lesson progresses and the time allotted to children to carry out a task, can effect learning. While analysing the data of the COs I saw evidence of sequencing and pacing of activities. For example, Joyce's first activity started with a song *Twinkle twinkle count the stars*. She then proceeded to give the children foil trays with laminated stars, number cards, beans to resemble rocks and laminated rockets. After allowing the children time to play, she intervened. She then extended the children's learning by doing

a follow-up activity where the children counted stars and chose the related number card. The steps Joyce used to structure the activity helped the children to engage with number recognition and value, using the follow-up activity to reinforce mathematical learning.

Data from the COs showed how the KGEs made use of the classroom walls to scaffold children's learning. As outlined in Section 4.6, the study was carried out during the COVID-19 pandemic and therefore wall displays were not allowed. However, the KGEs improvised and painted illustrations on the wall, including the number line from 1 to 10. During the classroom activities, the KGEs referred to the number line to scaffold children's learning. For example, during CO1, when a child told May that he counted 4 cars, she asked him to show her the number 4 on the number line to reinforce number recognition. Similarly, during Anna's CO2, the children counted the raindrops and then showed her the amount on the number line. Ruth used the number line while she was retelling the story *Ten Little Dinosaurs* as she asked different children to point to each number mentioned in the story.

Another scaffolding practice applied by the four KGEs was the classroom organisation in terms of the children's grouping. Each classroom had four round tables with three to four children grouped on each table. Grouping is considered by Anghileri (2006) as a scaffolding practice that enhances learning through peer collaboration. This was also evidenced by the KGEs during the SRIs when they maintained that they placed children in a mixed ability group so that they "help each other" in their learning. This is consistent with Fawcett and Garton's (2005) view who contend that peer collaboration between children of "a different knowledge base, ensure[s] that there is the necessary mismatch required to promote the re-examination of the child's own understanding that leads to internal reorganization and cognitive change"

(p. 160). The data from the COs, showed instances where one child influenced the performance of another child within the group. The following example shows how the scaffolding strategies of free play and grouping supported children's learning.

Ruth CO3: Children were each given foil trays with different sized cups, different sized pumpkins and carrots, white and brown beans and a set of number cards. After some time playing, a child started forming a pattern with the beans, uttering "1 white, 1 brown, 1 white, 1 brown". He repeated the pattern 7 times. Another child from the same table, after observing her peer, started forming a different pattern, 6 white, 2 brown, 6 white, 2 brown. This observation indicates that through free play, the actions of one child influenced the other to engage with the mathematical concept of pattern. Furthermore, this episode showed evidence of the scaffolding strategy parallel modelling, a strategy in Level 2 of Anghileri's (2006) hierarchy. The second child, after observing a parallel model made by their peer, transferred the understanding of pattern and created a different pattern. Pictures of the tasks can be seen in Figure 2.

Figure 2 - Different patterns with white and brown beans

The data from the COs also showed evidence of how environmental provision strategies were applied simultaneously to support the children's learning. Following is an example showing how the strategies of grouping, free play, artefacts, self-correcting tasks and emotive feedback assisted a child in their mathematical learning. During Joyce's third activity the children were each given Popsicle sticks, bottle caps, straws and 2D shapes in a tray. The KGE explained to me that she was hoping that the children would form rockets with the artefacts, thus linking rockets to shapes. While the teacher was observing their free play, a child formed a triangle with the Popsicle sticks. This is the conversation that ensued.

Child A: I made a square.
Child B: No, that is a triangle.
Joyce: How do you know that it is a triangle?
Child B: Because a triangle has 3 sides.
Child A: (She uses more Popsicle sticks and forms a square). Miss, look I made another shape.
Joyce: Good job. I can see that it's different from the other one.
Child A: Yes. This is a square and this (pointing to the triangle) is a triangle.

This finding implies that child B, who can be viewed as the more capable peer, influenced the performance of child A. This is in line with Vygotsky's (1978) view that a more knowledgeable peer can assist a less capable peer to correct misunderstandings and develop new knowledge to move forward in their ZPD. A picture of the task is shown in Figure 3.

Figure 3 - Triangle and square made by child A in Ms Joyce's class.

Furthermore, this interaction shows how Joyce's intervention assisted child A to self-correct themselves by forming the square and in addition, used emotive feedback to show approval of the child's actions and words.

5.4.2 Explaining, reviewing and restructuring

The scaffolding practices, *explaining, reviewing and restructuring*, involve the direct interaction of the KGEs with the children. Anghileri (2006) acknowledges that *explaining* or *showing and telling* restricts the children's thinking as the teacher has full control of the discussion. This is not in line with the emergent curriculum approach, where the teacher should take the role of the facilitator and direct learning towards the children's interests (Stacey, 2009). However, the data from the first round of COs revealed that the KGEs used this strategy in their activities. The KGEs were observed showing and instructing the children to carry out a specific task to target a mathematical learning outcome. For example, Anna, who intended to teach the children the notions of big and small, went round each table asking each child: "Show me the big cloud" and "Now show me the small cloud". Similarly, May instructed the children to count the cars in the foil tray, say the number and choose the matching number card. This shows that, rather than letting the children explore, the KGEs used direct instruction to lead children to mathematical learning. The strategy employed by the KGEs is similar to what Rogoff et al. (2003) refer to as *assembly-line instruction* where the "focus is on the products that learners are to produce" which makes "development of voluntary involvement difficult" (p. 195). Rogoff et al. (2003) highlight that for children to develop their learning they have to be interested, motivated and engaged in the task. This point was discussed during the first individual SRIs and all the KGEs were aware that showing

children what to do was not in line with the emergent curriculum approach. However, the KGEs were all open to discuss how the tasks could have been developed in ways which stimulate the children's mathematical interest and engagement, thus enhancing their learning.

Anghileri (2006) sustains that children's engagement with a task does not necessarily mean that they "identify those aspects most pertinent to the implicit mathematical idea" (p. 41). Thus, the teacher needs to focus the children's attention to the mathematical content. This is consistent with Lee and Ginsburg's (2009) view that adult guidance is necessary to elicit mathematical ideas from free play. The data from the COs revealed that although the foil trays included mathematics related artefacts, the children did not always engage with mathematical ideas. During the SRIs, the KGEs all highlighted that it was only occasionally that children engaged spontaneously in mathematical activity during play. Anghileri (2006) sustains that the teacher needs to apply the scaffolding strategy, *reviewing,* to stimulate the children's mathematical thinking. The data from the COs revealed that the KGEs employed this strategy to guide the children to mathematical learning and also to understand the children's actual level of mathematical understanding. For example, during CO3 May gave the children a foil tray with red, green and orange laminated circles (the circles representing the traffic lights) and poured some water in it. She also gave them two different sized cups. She was hoping that this learning invitation would direct the children's interest to mathematical content, mainly pattern and capacity. The children were observed to put their hands in the water, fill cups with water and empty them and pour water from one cup to the other. None of the children were noted to form patterns with the circles or use words that could be considered as having a link to mathematical content. Therefore, May went round the

classroom, prompting the children, to direct their attention to mathematical ideas and at the same time identify where each child stood in their learning. The following is an interaction that took place:

Child C: **Look Miss. I am filling the cups with water.**
May: **Very good. Are the cups the same?**
Child C: **No. One is big and one is small.**
May: **Can you show me the big cup.** (The child holds the big cup in his hand). **Now can you show me the small cup?** (The child lifts the small cup). **I can see that you have only filled the big one with water.**
Child C: **Yes and this is empty** (pointing to the small cup) **and this is full** (pointing to the large cup).

Through this interaction the KGE, using the strategies looking touching and verbalising, focused the child's attention to the mathematical content of measure. She extended the child's learning by prompting and probing to assist the child to justify and explain the concepts of big and small. Furthermore, she interpreted the child's actions when she referred to the cup filled with water, leading the child to demonstrate the idea of empty and full.

After *reviewing,* Anghileri (2006) proposes *restructuring* as the next scaffolding practice, to help students to advance in their learning. Once the KGEs establish the current level of mathematical knowledge of the children, the next step is to move the children forward in their mathematical learning. This is in line with Vygotsky's (1978) view that children need the assistance of a MKO to move children from their actual level of knowledge to their potential level, thus helping them move ahead in their ZPD. The data from the COs revealed that the KGEs applied the *restructuring* scaffolding strategy to move children forward in their learning by providing a meaningful context. This was seen when the KGEs presented mathematical learning opportunities integrated into the play activities by putting maths related artefacts in the foil trays. Tucker (2011) suggests that play trays which include mathematical content "can

provide excellent learning contexts for young mathematicians" (p. 17). Following is an example from the COs: In CO2, Joyce gave each child a tray with salt, small cotton balls, coloured rockets, number cards and laminated astronaut pictures. Guided by the KGE, the children engaged in mathematical activity including counting and finding the value shown on the number cards, making patterns and sorting. The following is an interaction that took place:

Child D: **I have many rockets.**
Joyce: **Ohh, how many?**
Child D: **I have 5.**
Joyce: **And if we add 1 more, how many rockets would you have?**
Child D: **6**
Joyce: **Good job! Now what if we add 1 more rocket?**
Child D: **7**

The data from this CO also showed that Joyce interacted with each child differently, asking questions according to the child's ability. Following is another interaction from Joyce's CO2:

Joyce: **I see that you are playing with the rockets. Can you tell me how many you have?**
Child E: **One, two, three, four, five.**
Joyce: **Very good. Can you show me the number 5 from the number cards?** (The child has difficulty identifying the number 5. The teacher takes number cards 1 to 5 from the tray and puts them on the table in front of the child).
Joyce: **Let's see, what numbers do we have here?**
Child E: **This is 1, 2, 3, 4 and this is 5. This is 5 Miss.**
Joyce: **Well done! Can you help me find the number 5 on the number line?** (Joyce points to the number line on the wall. Child D identifies the number 5).

The above interactions showed that although the children had the same mathematical content in the foil tray, Joyce used the play context to apply different strategies with the children according to their level of understanding. During the interaction with child D presented above, Joyce extended the child's reasoning on the understanding of number in terms of how the number sequence is created. With child E, Joyce, applied the scaffolding

strategy *simplifying the problem* (Anghileri, 2006) by making the number cards available to the child and used the number line to consolidate the child's number recognition.

Besides play activities, the data shows that the KGEs used books to provide a meaningful context to direct the children's attention to mathematical content and processes. Such an example could be seen in Anna's CO1, where she used the school yard to relate the story *The Little Cloud.* The KGE used the story to help children explore the increase of number and measures. Children were observed to make hand gestures depicting big (clouds) and little (clouds) and looking up at the sky, subitizing and counting the little clouds and the big clouds. Ruth also used the story *Ten Little Dinosaurs* during CO2 to focus the children's attention to mathematics learning. With her prompting, children were able to engage in problem solving and composing and decomposing numbers like for example when there were 3 missing dinosaurs out of 10, a child said: "3 dinosaurs went, now there are 7". Ruth also prompted the children to count back from 10 each time a dinosaur 'left' and count forward when each dinosaur 'returned'.

Rephrasing students' talk is a strand in Anghileri's (2006) *restructuring* scaffolding strategies where the teacher rewords the students' vocabulary to introduce the right mathematical terminology. According to the NCTM (2000), very young children often use everyday language to express mathematical ideas. Indeed, during the analysis of the data from the COs, there was evidence of children saying, for example, *shorter* instead of *lower*, *more big* instead of *bigger* or *box i*nstead of *square*. Evidence showed that the KGEs re-phrased the children's words using the correct mathematical terms.

5.4.3 Developing conceptual thinking

Developing conceptual thinking is Anghileri's (2006) highest level of scaffolding strategies, which includes *making connections* and *developing representational tools*. Anghileri (2006) states that these scaffolding strategies assist children in developing processes which lead to "generalisation, extrapolation and abstraction" (p. 47). While analysing the data from the COs, I was aware that since Anghileri (2006) proposed these scaffolding strategies for Primary school children, evidence of this theme would be limited in my research context. For example, when talking about *making connections*, Anghileri (2006) implied connections between mathematical concepts such as "doubling 6 instead of 6 add 6" (p. 48). Such a practice was not observed during the COs. This could have been because the children's mathematical knowledge at KGII level is still very limited. However, while analysing the data I noticed that the KGEs made a connection by connecting mathematics to real life. Evidence of this could be seen for example in Ruth's CO3 who was doing the project *On the Farm*. She gave children soil and hay and two same sized cups. The children started investigating by filling and emptying the cups with hay and soil. Assisted by Ruth, some children brought up the concepts of empty and full, and when one cup was full of hay and the other with soil, there were a few children who were able to distinguish between heavy and light. Another example of making connections to real life was seen in Joyce's CO3 when she provided children with things to make a ham and cheese sandwich. Guided by the KGE, children were observed to talk about the shape of the bread, the cheese and the ham and counting the slices. Joyce extended this activity by providing shapes of a sun, a moon and a star. She urged the children to estimate how many shapes they can cut from the sandwich and then put the shapes on the sandwich to check their answer. Thus, the activity helped the children to connect mathematics to real life while at the same time consolidating their mathematical concepts and processes.

Anghileri (2006) maintains that representational tools such as language, lead to mathematical reasoning. This is in line with Vygotsky's (1981) view that language is a psychological tool which "direct[s] the mind and behaviour" (p. 140) of children. The analysis shows that the KGEs used mathematical language as a scaffolding strategy to develop the children's mathematical thinking to move them forward in their ZPD. This was seen during the COs where the KGEs provided learning opportunities where children were observed to "articulate their reasoning" (NCTM, 2000, p. 58) by referring to objects using language such as *larger*, *smaller*, *heavier*, *lighter* and *more and less*.

Referring to representational tools, Anghileri (2006) also highlighted the use of images and symbols to develop conceptual thinking. Tools, according to Vygotsky (1981), act as mediators to lead children to higher mental functions. During the activities, the KGEs made use of a number of tools to scaffold children's learning and direct the children's attention to mathematical learning. These tools included number cards, the number line, 2D shapes, bottle caps and blocks. I can describe these tools as technical tools, or as Vygotsky explained (1978) tools with an external function. However, Kinard and Kouzulin (2008) explain that technical tools can transform into psychological tools once the children would have internalised their function. From the data it was revealed that, for some children, the number line was transformed from a technical tool into a psychological tool as they were able to sequence numbers up to 10 without referring to the number line. Thus the number line served as a tool to support the children's development within the ZPD.

5.4.4 Questioning strategies

According to Figueiredo et al. (2018) "teachers enhance children's Mathematics learning when they ask questions that provoke clarifications, extensions, and development of new understandings" (p. 537). The questions asked by the teachers should be open-ended to allow children "to notice think and express their ideas" (Clements et al., 2004, p. 85). Clements et al. (2004) argue that not all questions posed by the teacher are effective in leading children to think and construct new knowledge. While analysing the data of the COs, the theme of questioning strategies applied by the KGEs to scaffold the children's learning emerged. This was seen especially during the second and third round of COs. The findings show that during the first round of COs, the questions asked by the KGEs did not engage children in inquiry but were used to elicit the intended answer from the children. Following is an example from Anna's CO1:

Anna: What is this number? (She points to number 3)
Child F: 3
Anna: Can you show me 3 clouds?
Child F: (The child counts three clouds) 1, 2, 3

Anna moved on to ask the same type of questions to other children in the group. This implies that Anna identified the actual level of understanding of the child but failed to ask more questions to scaffold the child to his potential level of development. For example, Anna could have extended the child's learning by asking, 'What if you add 1 more cloud?' leading the child to investigate the concept of 'addition'. Similarly, during CO1, Joyce was very direct in her questioning techniques. During a teacher-led activity, Joyce used two small tables. On one she put 10 plastic stars while on the other she put number cards from 1 to 10. She called the children one by one. She told them to pick up the stars, drop them on the table and count only the number of stars which fell on the table. Following this, the children had to find the

matching number card from the other table. This is an example of an intervention that took place:

Joyce: How many stars fell on the table?
Child G: 6.
Joyce: Can you find the number six from there? (The child points to the card showing number 6).
Joyce: Good job! Now you can go back to your table.

The data from this intervention shows that the participation from the children's side was limited and directed and the questions were used to instruct the child to carry out a task. According to Chappell et al. (2008) questions should "offer the learners considerable time and space to generate ideas [to] shape and lead their own learning" (p. 283). After asking the question the teacher is attentive to and builds on children's responses, to scaffold their learning (Anghileri, 2006).

During the first SRIs, the questioning techniques applied by the KGEs during the first COs were discussed and questioning strategies, which may direct the children's attention to mathematics were explored. As a result, data from the second and third COs showed that each KGE endeavoured to ask guiding, rather than direct, questions to the children. An example of how questioning strategies were used to scaffold children's learning was seen during May's CO2. In her ongoing project about cars, May wished the children to explore the concept of measuring length within a playful context. She gave the children small cars and different coloured paint. Children dipped the cars in the paint and pushed them down a ramp. The cars left tyre marks on the ramp. This is an excerpt from the discussion that ensued with a group of 2 children:

May: I see that you drove your cars down the ramp.
Child H: Yes and they made lines.

May: I see. What can you tell me about the lines?
Child H: Mine is green.
Child I: Mine is yellow.
May: So they are different.
Child I: Yes different colours.
May: Can you notice something else which is different?
Child H: Mine is larger. It goes from here to here. (The child points to the beginning and the end of the green line).
May: And how is it larger?
Child H: **Because** [Child F]**'s line stops here** (pointing to where the yellow line stops) **and mine went on**.

The questions May used helped child H to engage with the concept of measurement. As outlined by Griffin (2004) "[C]areful teacher questioning […] encourage [s] children to focus on the knowledge the lesson was designed to teach and to help them deepen and broaden their understanding" (p. 336). Thus, May's initial question was an invitation for the children to engage with mathematical content (rather than colour), and she built on the children's responses by asking more questions to scaffold their learning.

Another example of a similar practice was noted during Ruth's CO3. A child, who was playing with two different sized cups and beans was observed filling the smaller cup with beans. Following is an excerpt of the discussion between Ruth and the child.

Ruth: What can you tell me about these two cups?
Child J: One is empty and one is full.
Ruth: Can you think of anything else you can tell me?
Child J: One is big and one is small.
Ruth: Very good! So is the big cup empty or full?
Child J: Empty and this (pointing to the small one) is full.
Ruth: What if we had to pour the beans from the small cup into the big cup? What happens? (The child pours the beans from the small cup into the big cup).
Ruth: What do you notice?
Child J: It is not full!
Ruth: Why do you think it is not full? What can we do to make it full?
Child J: We add more beans.
Ruth: Very good! So let's see where we can find more beans.

This episode indicates that Ruth's initial question was intended to draw the child's attention to the concepts of empty and full. She then scaffolded the child's learning by asking more question, leading the child to investigate and engage with the process of reasoning.

5.5 Main Theme 3: Integrating Mathematical Content into the Project Approach

Ginsburg (2006) highlights that "the project method […] situates the learning of mathematics in a highly motivating investigation" (p. 159). This is in line with Helm and Katz's view (2001) that the project approach engages children in "active investigation" which "provide[s] a natural provocation for learning and using mathematical thinking" (p. 8). This implies that, by adopting a project approach derived from the children's interests, the teacher creates learning opportunities where children can engage with mathematics through inquiry and investigation. The NCF (MEDE, 2012) recommends that such learning opportunities should "incorporate play and experiential joyful learning" (p. 34) including both adult-led and child-initiated activities. During the process of analysing the data from the COs, the theme of *teacher-led and child-initiated* mathematical learning opportunities emerged. The KGEs were observed to involve children in both teacher-led and child-initiated activities to direct the children's attention to mathematical concepts and processes. Furthermore, from the analysis of the COs, the theme of how the KGEs *assessed* the children's mathematical development emerged. According to the NCF (2012) assessment "in early childhood education is a means of finding out what children are interested in as well as finding ways of recording and documenting [the children's] progress and development" (p. 18). In the following sections I will discuss the findings related to the above mentioned themes.

5.5.1 Teacher-led and child-initiated mathematical learning opportunities

Lerkkanen et al. (2016) explain that while child-initiated practices allow children to investigate and construct their knowledge, during teacher-led practices, knowledge is structured by the teacher. The data from the first round of COs showed evidence that the KGEs employed mainly adult-led practices to engage children in activities which may be considered as mathematical. For example, during Ruth's activity, the children were involved in a dinosaur egg hunt. The 'eggs' were in the form of an oval 2D shape, half white and half coloured. Ruth hid the 'eggs' in the school yard and the children had to look for them and put the 'eggs' they collected in a basket provided by the teacher. Back in the classroom, Ruth used a clothes line to hang half coloured 2D ovals which resembled half 'eggs'. Underneath the clothes line, she put number cards 1 to 10 on a table. She called the children one by one and asked them to match the colour of the 'eggs' from their basket to the correct coloured half 'eggs' from the clothes line. Following this the children were asked to count the eggs and point to the correct number from the table (see Figure 4).

Figure 4 – Dinosaur egg activity

During this activity, the children were seen to be engaged in mathematical activity, however the KGE's instructions left no space for the children to investigate. During the SRI following this activity, Ruth acknowledged that the activity could have been developed differently to allow children time to think. An example of an option that was discussed was putting the half coloured 'eggs' on the children's tables instead of on the line and let the children explore. This may have directed the children's attention to pattern, sequence, counting, reasoning and problem solving. The KGE's role would have been to observe the children's actions and build upon their interest to engage them in mathematical learning.

Another example of a teacher-led activity was observed during Anna's CO1 during *The Weather* project. Anna gave children an A4 light blue paper telling them that it is like the sky. She put white paint blobs on half of the paper, helped children to fold it in two and to rub the folded sheet. Then she asked the children to open the paper and said, "Wow, look at how many clouds we have". Gesturing with her hands she told them, "We have a small cloud. Show me small with your hands and now show me big". The children were observed to show the teacher 'small 'and 'big' by first opening their hands a little apart and then opening them wide. Then Anna gave the children another paper telling them, "Now we are going to make a big cloud", repeating the same procedure as before. During this learning opportunity the KGE applied a teacher-directed practice where the children just followed instructions. At this stage, I questioned whether the children's gestures implied that they understood the concepts of 'big' and 'small'. van Oers (2010) argues, that one cannot assume that the children's participation in mathematics related activities develops their mathematical thinking, "even when they may carry out actions that we, as encultured adults, may recognise as mathematical" (p. 28). Moreover, no other activity took place where the children had the

opportunity to make size related comparisons which as Montague-Smith et al. (2017) argue are essential to the concept of *Measurement*.

The SRI following the above mentioned activity revealed that Anna was aware that the activity was teacher-directed and she was encouraged by the MKO to think of other strategies that could have been applied to direct the children's thinking to measures and comparing. In fact the data from Anna's CO3 showed evidence of how a child-initiated learning opportunity was developed to further children's understanding of the concept of measure. The ongoing project was *Bears* and Anna introduced the activity by narrating the story *Goldilocks and the Three Bears*. She then gave the children a foil tray with some coloured rice, 3 different sized plastic bears, different sized cups, Popsicle sticks, plastic numbers from 1 to 3, 3 different sized laminated bears and plastic spoons. Following is an interaction between Anna and a child.

Child K: Look Miss, I have a mum, dad and baby bear. (She picks up the largest bear). This is the biggest, daddy bear.
Anna: Ohh I see! And what about the other two bears? So that is daddy bear. And who are the others?
Child K: (She points to the smallest bear). This is baby bear and he's small. This one is mama bear (pointing to the medium sized bear). She's big not like baby.
Anna: So you have 2 big bears?
Child K: Yes but they're not the same.
Anna: Why?
Child K: This one is more big. (She points to the largest bear).
Anna: So it is bigger?
Child K: Yes bigger.
(The child places the plastic bears on the laminated bears according to size as can be seen in Figure 5).

Figure 5 – Comparing size

This interaction, shows how a child-initiated activity was developed by the KGE to further the child's mathematical engagement. With her prompting and questioning, Anna led the child to engage in mathematical reasoning involving measure. She followed up on the child's conversation and "seize[d] upon the teachable moment to foster [the child's] learning (Ginsburg, 2006, p. 159).

Another instance where the children's mathematical learning was enhanced was observed during May's CO2. The project being developed was *Cars.* During this activity which was teacher-initiated and child-led, the teacher gave the four groups of children a piece of rectangular cardboard and tape to construct a ramp. One group was observed to tape one side of the cardboard to the table. May approached the group and started a discussion with the children. This is the conversation that ensued:

May: You chose to tape the cardboard to the table. Why?
Child L: We are making the ramp.
Child M: Now we are going to stick it to the floor. (She points to the other end of the cardboard).
May: Do you think it will reach the floor?
Child L: (The child tries to touch the ramp to the floor but it was short).
Child M: It is not good.
May: Why?
Child L: It is small.

May: So what can we do? (The children do not reply so May prompts the children further). Can we tape it to something else perhaps? Let's take a look around the classroom.
Child L: Yes, to the chair. (She points to her chair).
May: Why did you choose the chair?
Child L: Because the chair is smaller.
May: Shall we try it out? (The children tape one end of the ramp to the chair and the other end to the floor).
Child M: Now it's good! (See Figure 6)

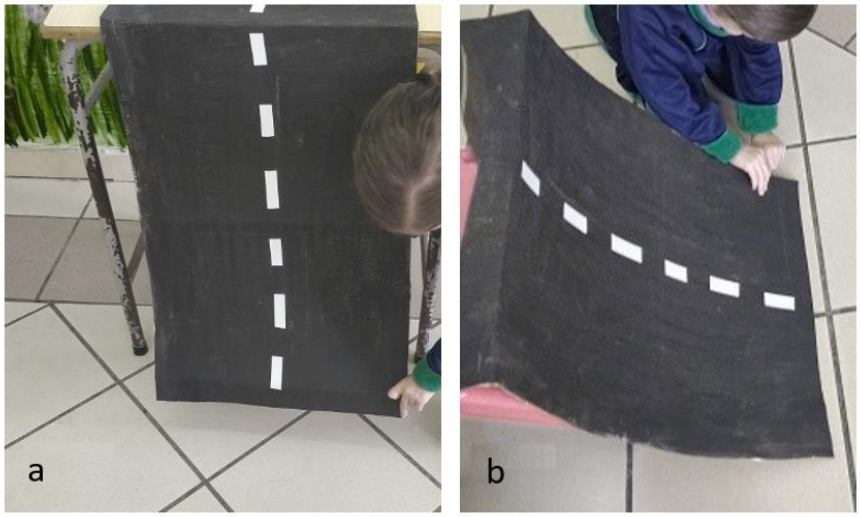

Figure 6 – (a) Ramp taped to a table, (b) Ramp taped to a chair

This interaction indicates that by prompting and questioning, May led the children to compare the height of the chair and the table and also to use comparative language such as smaller. Furthermore, her words guided the children to engage in mathematical reasoning and problem solving by encouraging them to explain and justify why they decided that the chair was the better option to tape the ramp to. According to van Oers (2010), "[o]nly when the adult reacts in a mathematical way to this action, […], does the child's action begin to gain mathematical meaning, especially when this is noticed by the child himself" (p. 29). In my opinion, May's intervention may be considered as pivotal in guiding the children to make a connection between their activity and mathematics learning.

All the learning opportunities mentioned above imply that the KGEs endeavoured to connect mathematical knowledge into the children's learning experience. During the adult-led activities the KGEs held full control of the learning that took place. However, during the activities which were either teacher-initiated and child led, or child-initiated, children were given opportunities to develop their mathematical learning. With the KGEs prompting and questioning the children were allowed to take control of their learning which according to Griffiths (2005), "is a very important aspect of teaching mathematics" (p. 173).

During FGD3, we discussed the strategies the KGEs used to create mathematical learning opportunities. The KGEs stated that prior to this study they were more inclined towards teacher-directed instruction and seldom used an investigative approach to enhance mathematical learning. This research project helped them to become aware that learning opportunities which are teacher-led can be developed into reasoning and problem solving activities. Thus, the KGEs understood that they should "strike a balance between providing structure or direction and expecting the children to take responsibility" (Griffiths, 2005, p. 173). Furthermore, the KGEs stated that the process of the research project was pivotal for them to embrace the change in their practice and now they feel more confident to implement the emergent curriculum approach practices.

On a similar note, the AH also stated that in their opinion, the research project was effective in the sense that, it assisted the KGEs to experience first-hand the ideal emergent curriculum approach practices. Furthermore, they believed that the support provided by the SLT member, helped the KGEs' professional development, which in turn, translated into supporting the children's learning and development. The AH also remarked that the fact that

Mathematics is not identified as a learning area in the Early Years, teachers may not give it its due importance. Thus, they stated that an approach similar to the one taken in the research project may prove to be very useful in the Early Years. Moreover, they highlighted that the school should provide programmes where SLT members collaborate with teachers to assist them in their professional development. They sustained that teachers need constant guidance and support to face the challenges they encounter in their practice.

5.5.2 Assessment

Clements (2004) maintains that "[a]ssessment that supports early childhood learning should enhance teachers' powers of observation and understanding of children's mathematical thinking and learning" (p. 62). During the analysis of FGD1, FGD3, COs and SRIs the theme of assessment emerged. The assessment strategies employed by the KGEs was initially discussed during FGD1. The KGEs highlighted that the assessment strategy used was mainly to ask questions to affirm the children's knowledge about a particular mathematical concept. The KGEs did not indicate that they used any other forms of assessment. Thus, at this stage, I directed the discussion to outline the importance and benefits of assessment which, as Carr (2001) maintains, is a tool which helps teachers to understand the children better, leading them to reflect on their practice and future planning. I also drew the KGEs attention to the notes provided during the training sessions by the Education authorities addressing the emergent curriculum approach (DLAP, 2020). One of the salient points in these notes is the importance of using different types of assessment, including, observing and listening to children, documenting children's talk and action and using open-ended questions (DLAP, 2020). These assessment strategies help teachers to acquire a thorough understanding of the children's learning which in turn informs their future planning (DLAP, 2020). All KGEs were

aware of these strategies, however they all stated that they did not use them for assessment purposes. For example, while discussing documentation, Anna stated that:

> I document children's work by taking photos. But I only do it to send evidence to the parents or to display them in the classroom. I never use them to determine the children's level of understanding.

Similar responses were recorded from the other KGEs. The data from FGD1 revealed that the KGEs agreed that they will endeavour to use different assessment strategies to determine the children's level of understanding. Furthermore, they outlined that they will use the findings from the assessments to plan ways of moving children forward in their development.

Indeed, during the COs, it was noted that the KGEs employed the assessment strategies of documentation, observations, questions and discussions to identify the level of the children's mathematical understanding. One such example could be seen during Joyce's second activity, when she was observed to take photos of the children's work. During the SRI she explained that:

> I uploaded the photos on the computer and then found the time, either at school or at home to write down brief notes about where the children stood in their learning. For example, I took a photo of [Child 1] putting the number cards in ascending order from 1 to 10. The photo showed that he was able to do it and I noted it down. So now I know that I can extend his learning by adding numbers 11 and 12 and maybe even up to 15. I also uploaded the photo on Microsoft Teams to inform his parents about their child's progress.

Thus, photos helped Joyce to review and reflect on the children's level of understanding with a view to extend the children's learning. Similar responses were recorded by Anna, Ruth and May during the SRIs, where they highlighted that they used photos to keep record of children's progress, to inform their future planning and to share the classroom experiences with parents.

The data from the COs also showed that the KGEs observed children to assess their level of mathematical engagement. A number of the learning opportunities involved giving the children a selection of objects to play with and to explore. The KGEs were noted to allow children time to play with the objects while they observed to what extent they became mathematically active. For example during Ruth's first activity, the children were given individual foil trays with coloured rice, pompoms, numbered Popsicle sticks, plastic cups, plastic spoons and laminated dinosaurs. When discussing the activity during the following SRI, Ruth stated that while observing the children she noticed that only one child engaged with mathematics spontaneously by starting to count the Popsicle sticks. The rest of the children had to be guided by her to engage in activities such as counting and sorting. In her opinion, the fact that the tray was filled with too many objects may have hindered the emergence of mathematical activity and "maybe less would have been better". She highlighted that the children were distracted by having so many things and they may have found it difficult to sort out or count so many objects. This implies that through observation Ruth assessed the situation and gained insight into the level of spontaneous mathematical engagement of the children which made her reflect on the way she planned learning opportunities.

The data also showed episodes where the KGEs extended assessment further, through observations by interacting with the children using questions and discussions. Through questioning and discussions the teachers "inquire so as to understand the children's thinking" (Clements, 2004, p. 63). Such an assessment practice was seen during May's third activity. May had previously discussed traffic lights and the zebra crossing with the children. She then gave children a number of red, orange and green circles together with white and black rectangles. May observed a child playing with the rectangles and circles, making a pattern

with the rectangles to form a zebra crossing and another pattern with the circles to form a set of traffic lights. She approached the child and interacted with him.

Child N: I am doing the traffic lights.
May: What are you using to make the traffic lights?
Child N: These (He points to the coloured circles).
May: And what shape are they?
Child N: Circles.
May: I can see that you also made this. (She points to the zebra crossing).
Child N: It's a zebra crossing.
May: Good job. And what did you use?
Child N: Rectangles. Black and white.

The above interaction indicates that May asked questions to assess the child's knowledge on the names of shapes. She was also observed to apply the same assessment strategy with other children. During the following SRI, May outlined that the observations, questioning and discussions with children about the shapes helped her to identify the children who still needed assistance in shape naming.

The assessment strategies applied to check for children's understanding were also discussed during FGD3. The KGEs were in agreement that the assessment strategies employed during this study were more beneficial for their practice. They indicated that the strategies assisted them to gain a deeper understanding of the children's level of learning. Furthermore, they were able to build upon the information acquired to develop the children's learning.

In addition, the KGEs highlighted that observing children communicating with each other during the activities also helped them to identify their level of understanding. Anna explained that:

When children are playing together they interact a lot and sometimes they explain and clarify things to each other. Their interaction helps me to understand the level of understanding of both the child who knows more and the one who knows less.

According to Carr (2001) the "process of assessment is like action research" (p. 13). The teacher interprets the observations of the child's actions, reflects on their practice and acts upon it.

5.6 Conclusion

In this chapter I presented an analysis and discussion of the data from this study. I initially outlined the three Main Themes and subsequent Subthemes that emerged from the data gathered from the FGDs, SRIs, COs and INT in the light of the Theoretical Framework and the research questions. The first Main Theme presented addressed the KGEs professional development, highlighting ways in which the MKO, through a collaborative approach assisted this development. The discussion focused on how the KGEs, with the MKO's assistance, developed strategies to integrate mathematics into the project approach. The second Main Theme explored the strategies applied by the KGEs to scaffold children's mathematical learning. Episodes from the COs were presented showing evidence of the different scaffolding strategies employed by the KGEs to move children forward in their ZPD. The third Main Theme focused on the pedagogical practices applied by the KGEs to integrate mathematics into the project approach. The analysis and discussion focused on how the KGEs used teacher-led, teacher-initiated and child-led and child-initiated learning opportunities in an attempt to integrate mathematics into children's learning experiences. In addition, the assessment strategies employed by the KGEs were discussed as a means for the KGEs to gain insight on

the children's level of understanding and to inform their future planning of mathematical learning opportunities.

Chapter 6 – Conclusion

6.1 Introduction

The aim of this research was to address the following research questions:

- *How can a member of the School Leadership Team work collaboratively with kindergarten educators to support them in their professional growth?*
- *How can this collaboration help kindergarten educators to devise a plan to incorporate the mathematical concepts and processes mentioned, or implied, in the Learning Outcomes Framework document for the Early Years (Levels 1-3) into the project approach?*
- *How can this collaboration support the implementation of the plan in the classroom, to provide children with opportunities to learn mathematics?*

In an attempt to answer the research questions, I, as a member of the Senior Leadership Team (SLT), worked in collaboration with four Kindergarten 2 (KGII) educators (KGEs) at my school through an action research approach. I wanted to work within my own community of practice to share my knowledge, experiences and thoughts with the KGEs on how mathematics learning can be integrated into the project approach. Furthermore, I envisaged that the participation of the KGEs in the action research process would lead to their professional growth and assist them to create learning opportunities that enhance the children's mathematical learning.

During the study, I took an interpretive stance since I wanted to interpret the KGEs own reality within a school context from their subjective viewpoint. Furthermore, the study

involved a process wherein the KGEs and the children acquired knowledge through interaction with others. Hence, I based my theoretical perspective on Vygotsky's (1978) sociocultural theory of development which highlights the importance of social interactions for learning and development and the need for a *More Knowledgeable Other* (MKO) to move learners forward within their *Zone of Proximal Development* (ZPD).

6.2 Summary of the Main Findings

Since I wanted to provide in-depth information about the process and implementation of the study, I adopted a qualitative approach (Mertens, 2014). I collected data through focus group discussions, classroom observations and stimulated recall interviews with four KGII educators. I also conducted two interviews with the Assistant Head of School to discuss the relevance of the study to the school. The findings from the data sets were analysed through a thematic approach, where pre-determined themes highlighted in my Theoretical Framework together with new emergent themes, were elicited. Ten themes were identified, which I grouped under three Main Themes as follows:

1. *Kindergarten educators' professional development* – This Main Theme included three pre-determined themes based on Warford's (2011) stages of Zone of Proximal Teacher Development (ZPTD), that is, *self-assistance*, *expert other assistance*, *internalisation and recursion.* I also identified a new emergent theme, *the collaboration between the MKO and the KGEs*.

2. *Supporting children's learning through scaffolding strategies* – A new emergent theme, *questioning strategies* and three pre-determined themes based on Anghileri's (2006) levels of scaffolding strategies, *environmental provision, explaining, reviewing and restructuring* and *developing conceptual thinking* were included in this Main Theme.

3. ***Integrating mathematical content into the project approach*** – This Main Theme incorporated two new emergent themes, *teacher-led and child-initiated mathematical learning opportunities* and *assessment.*

The first research question was addressed through the analysis and the discussion of the first Main Theme, *Kindergarten Educators' Professional Development*. The findings revealed that *the collaboration between the MKO and the KGEs* was pivotal to enhance the participants' professional growth. The KGEs reported that the guidance and support offered by the MKO (myself) who was also a member of the SLT, helped them to engage in a reflective process leading them to transform their practice. The data showed how the MKO applied Warford's (2011) stages of teacher development, through scaffolding practices as proposed by Wood et al. (1976), to enhance the KGEs professional growth to support children's learning. At the *self-assistance stage*, during the focus group discussion, the KGEs were able to reflect on their current practice and become aware that the strategies they applied in the classroom were not allowing children to "take an active role in the acquisition of learning and understanding" (Malaguzzi, 1998, p. 67). This is because the mathematical learning opportunities were presented to the children through an instructive process, wherein the teacher furnished knowledge through structured methods and pre-determined goals (Chen & McCray, 2014). However, with *expert other assistance,* the KGEs were able to elicit ideal strategies which allowed children to explore, inquire and construct new knowledge. With mediated assistance from the MKO, the KGEs were able to move from their current level of knowledge to a new set of knowledge and skills, thus move forward within their ZPTD (Warford, 2011).

The second research question was also addressed through the first Main Theme. The data revealed that at the initial stage of the study, the KGEs addressed the mathematical concepts and processes mentioned, or implied, in the Learning Outcomes Framework (LOF) as a stand-alone activity. With the assistance of the MKO, the KGEs planned three mathematical learning opportunities integrated into their projects, which they put into practice while the MKO observed. The observations gave the MKO insight into whether the KGEs had progressed towards *internalisation* in the sense that they "demonstrate[d] the capacity to use the pedagogical knowledge and skills espoused by their programme" (Warford, 2011, p. 255). The data from the KGEs first activity revealed that the KGEs still needed assistance to employ the ideal emergent curriculum pedagogical practices. Whilst the KGEs made some progress as they endeavoured to integrate mathematics into the project, they did not provide the children with opportunities to explore and inquire. However, the stimulated recall interviews following the classroom observation gave the KGEs the opportunity to "self-reflect and engage in dialogue" helping them to "review the value or effectiveness of their teaching strategies and enhance their teaching and learning" (Manesi & Betsi, 2013, p. 111). This reflective process led the KGEs to revisit the plans of the second classroom activities and with the MKO's assistance created opportunities which allowed for investigation and inquiry. The data from the observations and field notes of the second set of classroom activities revealed evidence of *internalisation* as the KGEs applied the ideal practices. Indeed, the KGEs did not require the assistance of the MKO to plan the third activity. Data from the third classroom observations and field notes showed signs of *internalisation* and *recursion* as the KGEs applied the ideal pedagogical knowledge acquired, repeatedly in the classroom.

The third research question was addressed through the second Main Theme, *Supporting children's learning through scaffolding strategies* and the third Main Theme, *Integrating mathematical content into the project approach*. The study showed how the SLT member supported the implementation of the planned mathematical learning opportunities by observing the classroom activities and then followed up with stimulated recall interviews that helped the KGEs to reflect and evaluate the outcome. The reflection process helped the KGEs to focus their attention on the children's learning and to evaluate how the classroom practices contributed towards developing the children's maximum potential (Silalahi, 2019). The findings showed how the MKO assisted the KGEs to transform their practice from creating teacher-directed learning opportunities to creating a balance of *teacher-led and child-initiated mathematical learning opportunities* through play. The evidence indicated that children benefitted more when activities included a balance of "sensitive instruction" by the KGEs and "creative construction" by the children (van Oers, 2014, p. 121). The "sensitive instruction" was necessary as children did not always engage with mathematical content and processes spontaneously and it was necessary that the adults direct the children's attention to mathematical content and processes (Lee & Ginsburg, 2009). The scaffolding strategies applied by the KGEs, *reviewing* and *restructuring, developing conceptual thinking and questioning strategies* were also seen to be important for the KGEs to draw the children's attention to mathematical content and processes, establish their current level of knowledge and build on that knowledge to assist the children to advance in their learning (Anghileri, 2006). In addition, *environmental provision* such as the classroom setting and tools, including images, symbols and language were observed to be effective to scaffold the children's learning and assist them in moving forward within their ZPD. Furthermore, during the focus group discussion, the MKO, guided the KGEs to apply *assessment* strategies during the

activities to determine the children's level of understanding and thus make informed decisions about future planning (DLAP, 2020).

6.3 Implications for Training

At the time of the study, the emergent curriculum approach to teaching and learning at kindergarten level, had been in place for two scholastic years. This approach is based on an extended consideration of a topic which is derived from the children's interest, thus allowing the children to inquire and investigate and become agents of their own learning (Helm & Katz, 2001). The KGEs had undergone training sessions offered by the Education authorities to adopt this approach which, as implied by the KGEs themselves, was not enough to implement the change. In fact, the findings from the first focus group discussion revealed that they were still employing a thematic approach to their practice. However, participation in the focus group discussion helped the KGEs to become aware of the changes they needed to make to apply the appropriate pedagogy. The discussion provided the space and time for the KGEs to raise their concerns regarding the implementation of the recommended pedagogy and to discuss the appropriate strategies. Taking this into consideration, it seems that the training sessions provided need to be extended so that practitioners can acquire enough knowledge and skills to embrace the change. Moreover, the KGEs were at first unsure of how to create child-initiated learning opportunities which allowed children to construct mathematical knowledge. Thus, it is suggested that the training is organised in such a way that practitioners are engaged in hands-on experiences as they put into practice the new pedagogy that is presented. As Peterson et al. (2010) sustain, "[p]rofessional development programmes that provide authentic, situated learning experiences over an

extended period of time are more likely to succeed in engaging educators and ultimately effecting change" (p. 157).

Early childhood practitioners should create play based learning opportunities that allow children to develop their maximum potential (MEDE, 2012). However, practitioners also need to "recognise mathematical actions in children" (van Oers, 2013, p. 271), in order to guide them to potential mathematical learning. Although I am aware that in the NCF "[d]iscrete learning areas are not proposed for the Early Years" (MEDE, 2012), I still recommend that practitioners receive training in Mathematics subject knowledge. According to Lee (2010) kindergarten educators' mathematics content knowledge is "a critical factor of children's mathematical achievements" (p. 28). When practitioners have sound subject knowledge, they will be in a better position to articulate the spontaneous actions of children and do not miss out on opportunities to develop the children's emergent mathematical learning.

6.4 Recommendations for Schools

The emergent curriculum approach to teaching in the early years aims to bring about a change from a traditional way of teaching to a more child-centred and inquiry based learning (MEDE, 2012). However, one cannot expect the KGEs, in isolation, to embrace the change and transform their practice. They need support at school level within their community of practice. Thus, school leaders need to collaborate and build relationships with the KGEs to effectively lead and support them through this change (Acton, 2021). Such collaboration and support can be provided by a designated member of the SLT, who has sound knowledge of the emergent curriculum approach and its implementation, and who can therefore act as a

point of reference for the KGEs. The findings from this study showed that the KGEs benefitted from the fact that they worked in collaboration with a SLT member who listened to their concerns and guided them to move ahead within their ZPTD. The focus group discussions and stimulated recall interviews allowed the KGEs the opportunity to share knowledge and, most of all, evaluate and reflect on their practice. From one activity to the next, the KGEs moved forward in their professional development as they felt more confident to implement the change.

The designated member of the SLT can also take on the role of a mentor to the KGEs. As a mentor, the SLT establishes a relationship with the mentee, based on mutual respect and trust, providing emotional support and advice, constructive feedback and pedagogical guidance (Manesi & Betsi, 2013). However, given the role of the SLT member within the school, it is important that the KGEs do not feel inhibited by the status of the mentor (Hobson et al., 2009). Thus, it is suggested that to mitigate against this factor, the KGEs participate in the mentoring process out of their own free will. The participation in the mentoring process will serve the KGEs "in that it encourages, empowers and enhances a continuing commitment of experiential learning at the heart of work-based practice and offers the possibility of change" (Fowler et al., 2009, p. 218).

As part of the continuous professional development of the KGEs, the school can organise a number of training sessions which address the implementation of the emergent curriculum approach. The training sessions can be organised in such a way as to build on the training provided by the Education authorities. The training can be carried out on the school premises by tutors who are specialised in early childhood education. This type of training will help the

KGEs to acquire more knowledge on the approach to teaching and learning, and this in their own context. In addition, the school can also invite the college Mathematics Support Teacher to organise sessions where mathematics learning at kindergarten level is discussed. Having school based training may help the KGEs to feel more confident to discuss within the group and voice any concerns, since the number of participants would be limited to the school's KGEs.

The recommendations for schools outlined above can all be incorporated into a school action plan. The action plan can be devised by the designated SLT member, in collaboration with the KGEs, as part of the School Development Plan (SDP). The development target for the action plan could be: *The implementation of the Emergent Curriculum Approach in the Early Years.* The action plan can include success criteria to reach the development target such as:

- creating a structure to develop project work,
- planning inquiry-based mathematics learning opportunities integrated into the project,
- devising strategies to scaffold children's learning, using various modes of assessment to understand the children's level of understanding and to inform future planning,
- mentoring,
- training.

The KGEs' contribution to the development of the action plan will give them a sense of ownership and commitment to the devised plan which may translate into the successful development and implementation of learning opportunities. Furthermore, school

development action plans are likely to be more successful when teachers collaborate and participate in the planning and implementation of strategic action (Carvalho et al., 2021).

6.5 Recommendations for the KGEs

Having discussed a number of recommendations for schools to support their KGEs, it is important to stress that educators also need to be willing to acquire new knowledge and improve their practice (Kyndt et al., 2016). Notwithstanding the fact that the participants in the study implied that they did not receive enough training, none of them referred to any spontaneous initiatives taken to acquire more knowledge. On an individual level, educators need to take the initiative and engage in learning activities that enhance their professional development. Such learning activities can include, for example, reading academic literature that addresses the learning and development of children. As Vygotsky (1978) outlines, child development and education are intricately linked, whereby the teacher who understands the child's development can guide them to move ahead within their ZPD. In addition, educators can also acquire knowledge through literature on the relevant pedagogical practices that support children's learning. The knowledge of child development combined with the ideal pedagogical practices, can help educators to foster a learning environment where children become critical thinkers and agents of their own learning (Daniels & Shumow, 2003).

Educators can also further their learning and development through collaboration with their peers thus allowing them to construct knowledge within their community of practice (Lave & Wenger, 1991). The findings in the study indicated that during the focus group discussions, the KGEs shared their classroom experiences and developed their knowledge and understanding of ideal pedagogical practices. Maltese KGEs can seize an opportunity to use

the weekly 90 minutes curriculum time, mandated by the Education authorities, to discuss and share strategies and techniques employed in the classroom. The classroom observations allowed me to experience the implementation of the mathematical learning opportunities. Similarly, educators can participate in peer observation sessions to experience, first-hand, the implementation of good practices within the classroom context. Peer observation provides an opportunity for the observer to become aware of, and reflect on, what is observed, and to consequently apply the knowledge acquired in the classroom (Hamilton, 2013).

The findings from this study indicated that the stimulated recall interviews helped the KGEs to reflect on their practice which, in turn, helped them move forward within their ZPTD. However, there was no evidence that the KGEs applied other spontaneous reflective practices to evaluate the outcome of the implementation of the planned learning opportunities. Warford (2011) highlights that teachers need to write down their experiences to "promote a more critical perspective on [their] beliefs and practices" (p. 255). Thus, it is suggested that educators keep a reflective journal. A reflective journal serves the educators to write down their thoughts and experiences which in turn engages them in the process of evaluating their practice. As such, the reflective journal can helps educators to become reflective practitioners, able to critically think about their practice and about the impact of their practice on the children's learning and development.

6.6 Limitations of the study

Notwithstanding the fact that this study had a successful outcome, I feel that it also had its limitations. First, the study was carried out in one particular school. Every school has its own

ethos and ways of doing things and consequently I cannot draw the conclusion that every school in Malta should take the same measures with regards to the implementation of the emergent curriculum approach. Second, the number of participants was limited and thus, I cannot conclude that the four KGEs who participated in the study represent all the KGEs working in the local Early Years sector. Consequently, one cannot generalise the results to all practitioners working in a kindergarten setting.

Third, the timeline of the action research was short. During the study I saw signs of internalisation on the part of the KGEs as they progressed in their development, and from one classroom observation to the next, they applied the appropriate pedagogical practice. However, I cannot assert that internalisation occurred in its entirety since I am not sure how the KGEs developed the project further and whether they integrated mathematics learning opportunities once the study was terminated. It is recommended that similar studies be carried out over a longer period of time to ensure a more sustainable outcome.

Finally, as I highlighted in Section 3.5, due to the COVID-19 restrictions the scaffolding strategy *Demonstration* (Wood et al., 1976) could not be applied. The KGEs were given the opportunity to discuss the classroom activities during the third focus group discussion. However, the discussion was limited since the KGEs did not experience each other's activities first-hand. Thus, they were not in a position to give each other feedback, which feedback may have contributed towards each other's professional development (Hamilton, 2013). Moreover, observing their peers would have given the KGEs "opportunities for affirmation of [their] own practice and pedagogy, [and they would have] consider[ed] what they and others do, in order

to construct opportunities for students' learning as well as improve their teaching practices" (Hamilton, 2013, p. 55).

6.7 Conclusion

"As a locus of engagement in action, interpersonal relations, shared knowledge, and negotiations of enterprises, […] communities [of practice] hold the key to real transformation – the kind that has real effects on people's lives" (Wenger, 1998, p. 85).

This action-research experience has helped me to gain insight on the benefits of working in collaboration within my community of practice. It has transformed my perception on my leadership role in the school. I have now become conscious of the challenges educators encounter when faced with changes in their practice and, as a leader, I am more aware of how I need to support them to embrace the change. Having seen the benefits of an action-reflection process, I envisage applying the same method, in an informal way, with other educators within my school community. In this way, the educators will have the opportunity to share expertise, experiences and knowledge with their colleagues which, in turn, will help them develop effective learning opportunities for the children. In addition, the fact that the other members of the SLT within my school were, to some extent, involved in the study, meant that they, too, realised the benefits of working closely with educators to enhance their professional development and children's learning. I am hopeful that this realisation will lead the SLT to devise a school action plan that targets programmes led by SLT members to support educators in an action-reflection process.

Finally, I hope that this study has enriched the participating KGEs' professional journey and has equipped them with further knowledge and skills that can be translated into learning opportunities that enable children to move forward in what Vygotsky (1978) termed their *Zone of Proximal Development*.

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Appendix 1

Guiding Questions - Focus Group Discussions

First Focus Group Discussion

1. Prior to the publication of the Learning Outcomes, what document/plan did you follow?

2. How did you plan for mathematics before the implementation of the new Learning Outcomes?

3. In your opinion, which are the mathematical concepts and processes mentioned or implied in the Learning Outcomes Document Levels 1-3?

4. What do you think of these Outcomes? (Positive aspects/negative aspects)

5. What strategies do you use to address these outcomes?

6. How is Maths integrated into the project?

7. Do you feel that this is the right approach?

8. Can you think of other strategies which can be applied?

9. What assessment strategies do you use? Why?

Second Focus Group Discussion

1. As you are aware during the last Focus Group discussion we drew out the mathematical concepts and process mentioned in the Learning Outcomes Document Levels 1-3.

2. How are we going to create learning opportunities to that can lead to mathematics learning?

3. What kind of resources do we need to stimulate the students' interest?

4. What language is to be used?

5. What are the methods that you will use to assess the students' understanding of the mathematical concepts? Please give me some examples

NOTE: It is anticipated that the focus group will take the form of a planning session.

Third Focus Group Discussion

1. Do you think that the teaching strategies you used helped the students to acquire mathematical knowledge?

2. If yes, which elements do you think helped to enhance students' understanding of concepts and processes? (resources/language)

3. Which mode of assessment did you use to check students' understanding?

4. Reflecting on the mathematical learning opportunities carried out, in what way has your teaching changed?

5. Can you mention any positive points or concerns (for teachers and students) that emerged from the delivery of the activity?

6. In what ways did the way we planned the activities together differ from your usual way of planning?

7. Do you feel that collaborative planning is effective? (Refer to focus group discussions and stimulated recall interviews). In what ways was the collaborative effort helpful to you?

8. If we were to do it again, or if I were to do it with another group of teachers, what suggestions do you have with regard to how the process of collaboration might be improved?

9. After the experience of this activity, how do you plan to address mathematical learning in the future?

Appendix 2

Classroom Observation Recording Sheet

KGE's name:
Date:
Time:
Classroom observation number:

1.Title of the project:

2.The Physical environment **a. Classroom setup:** **b. Displays:** **c. Grouping of children:**

3. Resources used by the teacher in the introduction of the activity (song/book/video, etc.) and if the KGE made any links to mathematics

4. How did the KGE incorporate mathematics in the current project plan?

5. Development of activity: **Tasks given to students:** **a. Resources used** **b. Teacher-led/teacher-initiated and child-directed/child-initiated**

6. Were resources used by KGE successful in engaging students' attention/interest? If yes, how? If no, why?

7. Did children engage spontaneously with mathematical content?

8. How did the KGE elicit mathematical learning?

a. Mathematical concept or process addressed

b. Strategies used in line with children's current level of understanding

c. Strategies used to scaffold children's learning:

d. Were strategies according to students' abilities?

9.Use of mathematical terms by:

a. KGE

b. Children

10. Was the task successful in assisting children to acquire mathematical knowledge?

11. What strategies were used by KGE to assess children's understanding of mathematical concepts?

12. Other comments

Appendix 3

Guiding Questions - Stimulated recall interviews – Kindergarten Educators

1. Did the activity turn out as you anticipated? If no, in what ways did it turn out differently?

2. How do you feel about how the activity proceeded?

3. To what extent was the activity child-initiated or teacher led? Why do you say this? – Please elaborate.

4. To what extent do you think the approach you used helped the students to focus on, and to understand, the mathematics concepts? Can you elaborate a bit by describing their actions and talk?

5. Which elements of the activity do you think helped to enhance students' understanding of concepts and processes? (Including resources you provided/language you used)

6. Tell me about your assessment strategies. What did you observe? What led you to reach these conclusions?

7. What can come next after this assessment of the activity / children's engagement?

8. To what extent did this activity contribute to the project being undertaken at present?

9. If you had to set the activity again, what changes, if any, would you make to the focus and/or organization? Why?

Appendix 4

Guiding Questions – Semi-structured interview – Assistant Head of School

First Interview

1. In October 2019, Kindergarten 2 Educators adopted the emergent curriculum and project approach. What are your views about this new approach?

2. Tell me about your experience of the change from the old guidelines/syllabi to the new Learning Outcomes.

3. Kindergarten Educators address the Learning outcomes Level 1-3. What are your views about these outcomes especially with reference to mathematics?

4. Do you think that the mathematical concepts and processes mentioned in the document address the mathematics which needs to be taught at kindergarten level?

5. What is your perception of teachers' challenges with addressing mathematics through the LOs?

6. What positive thoughts do you think your teachers' have with regard to addressing mathematics through the LOs?

7. What, in your opinion, are the best ways to create learning opportunities so that students would understand mathematical concepts and processes in-depth?

8. To what extent do you feel that a collaborative approach between a member of the SLT and Kindergarten Educators can help to devise a plan to incorporate mathematical concepts and processes in project plans to enable in-depth mathematical learning opportunities?

9. Knowing the aims of my project, what would you wish to come out of the study?

10. Would you like to add anything else?

Second Interview

1. Now that the Kindergarten Educators have implemented the plan, do you think that this approach has helped to enable in-depth mathematical learning opportunities?

2. If yes, what in your opinion were the major factors that helped to achieve this? If no, what do you think could have been done better?

3. How effective do you think the involvement of the SLT will be to support the implementation of such plans?

4. What type of measures can the school take to make a collaborative approach sustainable?

5. Do you think that this approach can be used in other year groups? In what way exactly?

Appendix 5

L-Università ta' Malta

Faculty of Education
University of Malta
Msida MSD 2080, Malta

Tel: +356 2340 3058/2932
educ@um.edu.mt

www.um.edu.mt/educ

23rd November 2020

RE: Application for Research Ethics Clearance 5402_25062020_Josette Grech

Dear Ms Grech,

With reference to your application 5402_25062020_Josette Grech for Research Ethics clearance, I am pleased to inform you that FREC finds no ethical or data protection issues in terms of content and procedure.

You may therefore proceed to approach potential informants to collect data using the tools/documents outlined in this application.

You are reminded that it is your responsibility - under the guidance of your supervisor - to distribute Information Letters and Consent/Assent Forms that are written in appropriate and correct English and Maltese.

Yours sincerely

Prof. Suzanne Gatt
Chairperson Faculty Research Ethics Committee
Faculty of Education

Appendix 6

DIPARTIMENT GHALL-KURRIKULU, TAGHLIM TUL IL-HAJJA U IMPJEGABILITA`
FLORIANA FRN 1810

DEPARTMENT FOR THE CURRICULUM, LIFELONG LEARNING AND EMPLOYABILITY (DCLE)
FLORIANA FRN 1810

Directorate for Research, Lifelong Learning and Employability

Tel: 25982743 researchandinnovation@ilearn.edu.mt

PERMISSION TO CONDUCT RESEARCH STUDY

Date: 13th September 2020

Ref: R08-2020 371

To: **Head of School**
From: **Director**

Title of Research Study: ***Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project.***

The Directorate for Research, Lifelong Learning and Employability would like to inform that approval is granted to **Josette Grech** to conduct the research in State Schools according to the official rules and regulations, subject to approval from the Ethics Committee of the respective Higher Educational Institution.

The researcher is committed to comply with the General Data Protection Regulation (GDPR) and will ensure that these requirements are followed in the conduct of this research. The researcher will be sending letters with clear information about the research, as well as consent forms to all data subjects and their parents/guardians when minors are involved. Consent forms should be signed in all cases particularly for the participation of minors in research.

For further details about our policy for research in schools, kindly visit www.research.gov.mt

Thank you for your attention and cooperation.

Claire Mamo
MA Ed (Open)
Research Support Teacher
Directorate for Research, Lifelong Learning and Employability

f/ Alex Farrugia
Director
Directorate for Research, Lifelong Learning and Employability
Great Siege Road | Floriana | VLT 2000
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MINISTRY FOR EDUCATION AND EMPLOYMENT

Appendix 7

Permission Letter – Head of the College

[Date]

Dear [Name of Head of the College]

I am Josette Grech, an Assistant Head at [Name of School]. I am presently reading for a Master of Education in Early Childhood and Primary Education (Mathematics Education) at the University of Malta. As part of the programme, I will be conducting a research study entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project'' under the supervision of Dr. Marie Therese Farrugia. The aim of this study is to work collaboratively with four Kindergarten Educators at my school, in order to carry out an in-depth analyses of the teaching of mathematics at Kindergarten 2 level. We will discuss in detail the mathematical concepts and processes mentioned or implied in the Learning Outcomes Framework document and work out a plan to integrate these outcomes in the project approach.

For this study I wish to work collaboratively with four Kindergarten 2 Educators to investigate the mathematical teaching being carried out in their classroom and the pedagogy being used. Together we will draw out the mathematical concepts and processes mentioned or implied in the Learning Outcomes Framework document, related to the early years (ages 0 – 7) and work out a plan to create learning opportunities, that address mathematical concepts and processes in-depth. Each Kindergarten Educator will carry out three mathematics related activities of 45 minutes each during which I will be an observer. During these observations I will take down written notes. I will also be considering the children's contributions as data. Part of my study would be to conduct three audio-recorded focus group discussions, of 45 minutes each, with the four Kindergarten Educators at their convenience. I would also like to carry out two audio-recorded semi-structured interviews with the Head of School.

In order to mitigate against my dual role (researcher/Assistant Head of School), I will ask the Head of School to act as an intermediary to invite the Kindergarten Educators to participate in the research. I will also ask one of the other Assistant Heads of School to act as a critical friend. The Assistant Head of School will be invited to monitor the Focus Group discussions to see that no pressure is exerted on the participants and that everything is running in an ethical way.

Should the Kindergarten Educators accept to participate, the consent forms will be returned to the Head of School who will in turn pass them on to me. Once consent is obtained from the Kindergarten Educators, I wish to ask the Kindergarten Educators to pass on Information Letters and Consent Forms to the parents of the students in their class. The parents' consent forms will be returned to the Kindergarten Educators who will then pass them on to me. With the assistance of the Kindergarten Educators, we will be explaining to the children my presence during the observation of the activities. The students will be given an assent form to colour a face according to their choice to participate in the study. Those students who do not give their assent will still be present during class observations

but I will only take into consideration the contribution of those students who both they and their parents agree to participate in the study.

I anticipate that the results from this research would bring a change in the educators' practice and would also empower them to devise a school action plan for the early years which addresses the implementation of the mathematics learning outcomes. Furthermore, my aim is that the educators taking part in this study will then share their expertise with their colleagues.

Participation in the study is voluntary and participants have a right to withdraw from this research at any time without stating a reason or without any negative consequences. If a Kindergarten Educator withdraws, the observations in her class will stop. In this case, all of the information collected pertaining to that participant will not be used for the study, and it will be destroyed. However, in the case of the Focus Group discussions, it may not be possible to remove data due to the interwoven nature of the discussion.

All raw data will be securely stored and the data obtained will be accessed only by myself and my supervisor and used solely for the compilation of my dissertation. The school will be given a fictitious name so that its identity will not be disclosed. I will use pseudonyms in my write-up to keep the identity of the participants confidential. However, since in my dissertation I would state my position in the school, there may be a chance that the school is identified.

I would be grateful if you would give me permission to conduct this research study at [Name of school]. Should you require further information, please do not hesitate to contact me or my supervisor.

Thank you for your kind consideration,

Yours Sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Supervisor's Name: Dr. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia@um.edu.mt
Office Telephone number: 2340 2933

Appendix 8

Permission Letter – Head of School

[Date]

Dear [Name of Head of School]

I am presently reading for a Master of Education in Early Childhood and Primary Education (Mathematics Education) at the University of Malta. As part of the programme, I will be conducting a research study entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project''. The study will be carried out under the supervision of Dr. Marie Therese Farrugia. The aim of this study is to work collaboratively with four Kindergarten Educators in order to carry out an in-depth analysis of the teaching of mathematics at Kindergarten 2 level. We will discuss in detail the mathematical concepts and processes mentioned or implied in the Learning Outcomes Framework document and work out a plan to integrate these outcomes in the project approach. I would like to ask your kind permission to conduct my research study at your school.

For this study I wish to work collaboratively with four Kindergarten 2 Educators to investigate what mathematical teaching is being carried out in their classroom and the pedagogy being used. Together, we will first draw out the mathematical concepts and processes mentioned or implied in the Learning Outcomes Framework document, related to the early years (ages 0 – 7). Then we will work out a plan to create learning opportunities that address mathematical concepts and processes in depth. Each Kindergarten Educator will carry out three mathematics related activities of 45 minutes each during which I will be an observer. During these observations I will take down written notes. I will also be considering the children's contributions as data. Part of my study would be to conduct three audio-recorded Focus Group discussions, of 45 minutes each, with the four Kindergarten Educators at their convenience. I would also like to carry out two audio-recorded semi-structured interviews with you as the Head of School.

In order to mitigate against my dual role (researcher/Assistant Head of school), I would like to invite one of the other Assistant Heads of school to act as a critical friend. The Assistant Head of School will be invited to monitor the Focus Group discussions to see that no pressure is exerted on the participants and that everything is running in an ethical way.

Should you grant permission to conduct the research study within your school, I would be grateful if you would act as an intermediary to distribute Information Letters and Consent Forms to the Kindergarten Educators. I wish to ask the Kindergarten Educators to pass on Information Letters and Consent Forms to the parents of the students in their class. The parents' consent forms will be returned to the Kindergarten Educators who will then pass them on to me. With the assistance of the Kindergarten Educators, we will be explaining to the children my presence during the observation of the activities. The students will be given an assent form to colour a face according to their choice to participate in the study. Those students who do not give their assent will still be present during

class observations but I will only take into consideration the contribution of those students who both they and their parents agree to participate in the study.

I anticipate that the results from this research would bring a change in the educators' practice and would also empower them to devise a school action plan for the early years which addresses the implementation of the mathematics learning outcomes. Furthermore, my aim is that the educators taking part in this study will then share their expertise with their colleagues.

Participation in the study is voluntary and participants have a right to withdraw from this research at any time without stating a reason or without any negative consequences. If a Kindergarten Educator withdraws, the observations in her class will stop. In this case, all of the information collected pertaining to that participant will not be used for the study, and it will be destroyed. However, in the case of the Focus Group discussions, it may not be possible to remove data due to the interwoven nature of the discussion.

All raw data will be securely stored and the data obtained will be accessed only by myself and my supervisor and used solely for the compilation of my dissertation. The school will be given a fictitious name so that its identity will not be disclosed. I will use pseudonyms in my write-up to keep the identity of the participants confidential. However, since in my dissertation I would state my position in the school, there may be a chance that the school is identified.

I would be grateful if you would give me permission to conduct the research study at your school. Should you require further information, please do not hesitate to contact me or my supervisor.

Thank you for your kind consideration,

Yours Sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Supervisor's Name: Dr. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia@um.edu.mt
Office Telephone number: 2340 2933

Appendix 9A

Information Letter – Head of School

[Date]
Dear [Name of Head of School]

I am presently reading for a Master of Education in Early Childhood and Primary Education (Mathematics Education) at the University of Malta. As part of the programme, I will be conducting a research study entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project'' under the supervision of Dr. Marie Therese Farrugia. The aim of this study is to work collaboratively with four Kindergarten Educators in order to carry out an in-depth analyses of the teaching of mathematics at Kindergarten 2 level.

I would like to invite you to participate in two semi-structured interviews of approximate duration 45 minutes. The first interview will focus on your views on the project approach in general, the learning outcomes and my research interest as relevant to the school. The second interview will be held after I carry out the activity observation to discuss the outcomes of the action research.

The interview may be held on school premises during school hours but, should you prefer, it may also be held at another location and time of your choice. With your consent, the interviews will be audio-recorded for transcription purposes. All raw data will be securely stored and the data obtained will be accessed only by myself and my supervisor and used solely for the compilation of my dissertation. Once I have completed the dissertation successfully the audio-recorded data will be destroyed.

The school will be given a fictitious name so that its identity will not be disclosed. I will use pseudonyms in my write-up to keep your identity confidential. However, since in my dissertation I would state my position in the school, there may be a chance that the school is identified.

In order to mitigate against my dual role (researcher/Assistant Head of school), I would like to ask you to act as an intermediary to invite teachers to participate in this research.

Participation in the study is voluntary and you have a right to withdraw from this research at any time without stating a reason or without any consequences. If you choose to withdraw, the interview data collected will not be used for the study, and it will be destroyed.

If you wish to participate in the interviews, kindly fill in the attached consent form.

Yours Sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Supervisor's Name: Dr. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia@um.edu.mt
Office Telephone number: 2340 2933

Consent Form – Head of School

Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project.

I confirm that I have read the attached Participant Information Letter regarding this study and that I have had the opportunity to ask questions and discuss the study.

On the basis of the information given, I consent to:

- Act as an intermediary to invite teachers to participate in this research
- Participate in two semi-structured interviews
- Allow Ms Josette Grech to audio- record the interviews

I understand that:

- Although Ms Josette Grech will use fictitious names, the interview may be attributable to me, since in the dissertation Ms Josette Grech will state her position as the Assistant Head of school.
- I may withdraw from the study at any time without giving a reason, and without there being any negative consequences. Should I withdraw, Ms Josette Grech will destroy the interview data collected.
- The audio-recordings will be stored safely and used solely for transcription purposes. The recordings will be destroyed once the study is completed.

_____	_____	_____
Head of School's name	Head of School's signature	Date

_____
Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Appendix 9B

Information Letter – Assistant Head of School

[Date]

Dear [Name]

I am presently reading for a Master of Education in Early Childhood and Primary Education (Mathematics Education) at the University of Malta. As part of the programme, I will be conducting a research study entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project'' under the supervision of Prof. Marie Therese Farrugia. The aim of this study is to work collaboratively with four Kindergarten Educators in order to carry out an in-depth analysis of the teaching of mathematics at Kindergarten 2 level.

I would like to invite you to participate in two semi-structured interviews of approximate duration 45 minutes. The first interview will focus on your views on the project approach in general, the learning outcomes and my research interest as relevant to the school. The second interview will be held after I carry out the activity observation to discuss the outcomes of the action research.

The interview may be held on school premises during school hours but, should you prefer, it may also be held at another location and time of your choice. With your consent, the interviews will be audio-recorded for transcription purposes. All raw data will be securely stored and the data obtained will be accessed only by myself and my supervisor and used solely for the compilation of my dissertation. Once I have completed my studies successfully the audio-recorded data will be destroyed.

The school will be given a fictitious name so that its identity will not be disclosed. I will use pseudonyms in my write-up to keep your identity confidential. However, since in my dissertation I would state my position in the school, there may be a chance that the school is identified.

Participation in the study is voluntary and you have a right to withdraw from this research at any time without stating a reason or without any consequences. If you choose to withdraw, the interview data collected will not be used for the study, and it will be destroyed.

If you wish to participate in the interviews, kindly fill in the attached consent form.

Yours Sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Supervisor's Name: Prof. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia@um.edu.mt
Office Telephone number: 2340 2933

Consent Form – Assistant Head of School

Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project.

I confirm that I have read the attached Participant Information Letter regarding this study and that I have had the opportunity to ask questions and discuss the study.

On the basis of the information given, I consent to:

- Participate in two semi-structured interviews
- Allow Ms Josette Grech to audio- record the interviews

I understand that:

- Although Ms Josette Grech will use fictitious names, the interview may be attributable to me, since in the dissertation Ms Josette Grech will state her position as the Assistant Head of school.
- I may withdraw from the study at any time without giving a reason, and without there being any negative consequences. Should I withdraw, Ms Josette Grech will destroy the interview data collected.
- The audio-recordings will be stored safely and used solely for transcription purposes. The recordings will be destroyed once the study is completed.

_____	_____	_____
Assistant Head of School's name	Assistant Head of School's signature	Date

_____
Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Appendix 10A

Information Letter – Kindergarten Educators

[Date]

I am presently reading for a Master of Education in Early Childhood and Primary Education (Mathematics Education) at the University of Malta. As part of the programme, I will be conducting a research study entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project'' under the supervision of Dr. Marie Therese Farrugia. The aim of this study is to carry out an in-depth analysis of the teaching of mathematics at Kindergarten 2 level.

I would like to invite you to participate in my research study. I wish to collaborate with you to investigate what mathematical teaching is being carried out in your classroom and the pedagogy being used. Together we will draw out the mathematical concepts and processes mentioned or implied in the Learning Outcomes Framework document related to the early years (ages 0 – 7). This will be carried out through the first Focus Group discussion with all 4 Kindergarten 2 Educators at your school. Through a second Focus Group we will work out a plan together, to create learning opportunities which address the mathematical concepts and processes in-depth. Should you accept to participate, I would kindly ask you to carry out three activities of approximately 45 minutes each to implement the plan. I will sit in for these sessions and take hand written notes about the strategies and resources used during the activity. We will then assess the implementation of the learning opportunities during the third Focus Group discussion. The Focus Group discussions and activities will be held at a time and place convenient for you. With your consent, the Focus Group discussions will be audio-recorded, as I would need to transcribe the discussion for the analysis. Once I have completed my studies successfully the audio-recorded data will be destroyed.

I would also like to ask you to give out Information Letters and Consent Forms to the parents of the students in your class. The parents will return the consent forms to your kind self and I will collect them. I would also like you to assist me to explain to the students my presence during the observation of the activities. The students will be given an assent form to colour a face according to their choice to participate in the study. Those students who do not give their assent will still be present during class observations but I will only take into consideration the contribution of those students who both they and their parents agree to participate in the study.

Participation in the study is voluntary and you have a right to withdraw from this research at any time without stating a reason or without any consequences. If you choose to withdraw, the observations will stop. In this case, all of the information collected during observations, will not be used for the study, and it will be destroyed. However, in the case of the Focus Group discussions, it may not be possible to remove data due to the interwoven nature of the discussion. All raw data will be securely stored and the data obtained will be solely used for the compilation of my dissertation. I will keep your identity, and that of the school, confidential and anonymised in my write-up through the use of pseudonyms. However, since in my dissertation I would state my position in the school, there may be a chance that the school is identified.

If you agree to participate, kindly fill in the attached consent form and return it to the Head of School by [Date].

Should you require further information please do not hesitate to contact me or my supervisor.

Yours sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Supervisor's Name: Dr. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia@um.edu.mt
Office Telephone number: 2340 2933

Consent Form – Kindergarten Educators

Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project.

I confirm that I have read the attached Participant Information Sheet regarding this study and that I have had the opportunity to ask questions and discuss the study.

On the basis of the information given, I give consent to:

- Participate in three Focus Group discussions
- Allow Ms Josette Grech to audio- record the Focus Group discussions
- Allow Ms Josette Grech to observe three activities carried out in my classroom
- Take notes about the strategies and resources used during the activity

I understand that:

- The school and my identity will be anonymised. However, since in the dissertation Ms Josette Grech will state her position as an Assistant Head of school, there may be a chance that the school is identified.
- I may withdraw from the study at any time without giving a reason, and without there being any negative consequences. Should I withdraw Ms Josette Grech will destroy the information collected during observations conducted in my classroom. However, in the case of the focus group discussions, it may not be possible to remove data due to the interwoven nature of the discussion.
- The audio-recordings will be stored safely and used solely for transcription purposes. The recordings will be destroyed once the study is completed.

_____	_____	_____
Kindergarten Educator's name	Kindergarten's signature	Date

_____

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Appendix 10B

Information Letter – Kindergarten Educators

[Date]

Further to the information letter, regarding the research study I am conducting, entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project'' under the supervision of Prof. Marie Therese Farrugia, I would also like to invite you to participate in an interview after each activity. During these interviews, we will evaluate the activity together and find ways on how we can improve on the next activity.

The interviews will be held at a time and place convenient for you. With your consent, these interviews will be audio-recorded, as I would need to transcribe the discussion for the analysis. Once I have completed my studies successfully, the audio-recorded data will be destroyed.

Participation in the interviews is voluntary, and you have the right to carry out the class activity without participating in the interviews and to withdraw from participating in these interviews at any time without stating a reason or without any consequences.

If you agree to participate, kindly fill in the attached consent form and return it to the Head of School by [Date].

Should you require further information please do not hesitate to contact me or my supervisor.

Yours sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 9986304

Supervisor's Name: Prof. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia@um.edu.mt
Office Telephone number: 23402933

Consent Form – Kindergarten Educators

Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project.

I confirm that I have read the attached Participant Information Sheet and that I have had the opportunity to ask questions and discuss the study.

On the basis of the information given, I give consent to:

- Participate in an interview after each activity.

I understand that:

- I may withdraw from participating in the interviews at any time without giving a reason, and without there being any negative consequences.
- The audio-recordings will be stored safely and used solely for transcription purposes. The recordings will be destroyed once the study is completed.

_____	_____	_____
Kindergarten Educator's name	Kindergarten's signature	Date

_____

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Appendix 11

Information Letter – Assistant Head of School (Critical Friend request)

[Date]

Dear [Name of Assistant Head of School]

I am presently reading for a Master of Education in Early Childhood and Primary Education (Mathematics Education) at the University of Malta. As part of the programme, I will be conducting a research study entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project'' under the supervision of Dr. Marie Therese Farrugia. The aim of this study is to work collaboratively with four Kindergarten Educators in order to carry out an in-depth analysis of the teaching of mathematics at Kindergarten 2 level. We will discuss in detail the mathematical concepts and processes mentioned or implied in the Learning Outcomes Framework document and work out a plan to integrate these outcomes in the project approach.

For this study I wish to work collaboratively with four Kindergarten 2 Educators to investigate the mathematical teaching being carried out in their classroom and the pedagogy being used. Together we will draw out the mathematical concepts and processes mentioned or implied in the Learning Outcomes Framework document, related to the early years (ages 0 – 7) and work out a plan to create learning opportunities, that address mathematical concepts and processes in-depth. Part of my study would be to conduct three audio-recorded Focus Group discussions, of 45 minutes each, with the four Kindergarten Educators.

In order to mitigate against my dual role (researcher/Assistant Head of school), I would like to ask you to act as a critical friend. This will involve monitoring the focus group discussions, stimulated recall interviews and classroom observations to see that no pressure is exerted on the participants and that everything is running in an ethical way. You may wish to observe parts of, or the entire focus group discussions, stimulated recall interviews and classroom observations.

If you accept to act as a critical friend, kindly fill in the attached consent form.

Yours Sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Supervisor's Name: Dr. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia @um.edu.mt
Office Telephone number: 2340 2933

Consent Form – Assistant Head of School (Critical Friend request)

Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project.

I confirm that I have read the attached Information Sheet regarding this study and that I have had the opportunity to ask questions and discuss the study.

On the basis of the information given, I consent to act as a critical friend and sit in for parts of or the entire focus group discussions, stimulated recall interviews and classroom observations.

_____	_____	_____
Assistant Head of School's name	Assistant Head of School's signature	Date

_____
Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Appendix 12

Information Letter – Parent/Guardian, for Student's participation

[Date]

Dear Parent

I am Josette Grech, the Assistant Head of your child's school. I am presently reading for a Master of Education in Early Childhood and Primary Education (Mathematics Education) at the University of Malta. As part of the course, I will be conducting a research study entitled ''Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project'' under the supervision of Dr. Marie Therese Farrugia. The aim of this study is to work collaboratively with four kindergarten educators in order to carry out an in-depth analysis of the teaching of mathematics at Kindergarten 2 level.

As part of the study I would like to sit in your child's classroom while the teacher is doing activities on Mathematics. During the activities, I will take down notes about the strategies and resources being used to teach mathematical concepts at Kindergarten 2 level. I may also need to take down notes regarding your child's contribution during the activity. It may also be necessary for me to take photos of your child's work. *Care will be taken so that no photos will be taken of your child, himself/herself.* The notes and photos taken may be used as data and will be stored safely and accessed only by myself and my supervisor. Please note that your child's teacher will be explaining the study to the class, and I will also be obtaining the child's assent in a manner that is easy for him/her to understand.

In my dissertation, and in any future reports, I will use fictitious names so that the school and the identity of the teacher will be anonymised. Your child's name will not be used in any writing.

Participation is voluntary. If you do not wish your child to be part of my study, he/she will participate in the class activities as usual, and I will not take any notes about him/her or photos of his/her work. You and your child may change your minds with regard to his/her participation in the study without there being any negative consequence. Should you wish me to use your child's contribution as part of my study, kindly fill in the attached consent form and return it to the class teacher in the envelope provided by [Date].

If you require any further information please do not hesitate to contact me or my supervisor.

Thank you for you.

Yours sincerely

Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Supervisor's Name: Dr. Marie Therese Farrugia
Supervisor's email address: marie.t.farrugia@um.edu.mt
Office Telephone number: 2340 2933

Consent Form- Parent/Guardian, for student participation

Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project.

I have read the attached Parent/Guardian Information. I give consent for my child to participate in Ms Josette Grech's study.

I understand that:

- I am free to withdraw my consent at any time in the course of the study.
- My child will also be asked to give his/her assent and s/he is free to choose to participate in the study.
- The notes taken will be stored securely and will only be accessible to Ms Josette Grech and her supervisor.
- The school and the identity of the teacher will be anonymised since Ms Josette Grech will use fictitious names in her write-up.
- My child's name will not be used in any write-up.

_____	_____
Son/Daughter's name	Parent/Guardian's Name
_____	_____
Date	Parent/Guardian's signature

_____
Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Ittra lill-Ġenituri/Gwardjani – Parteċipazzjoni tat-tfal

[Data]

Għażiż Ġenitur

Jien Josette Grech, l-Assistenta Kap tal-iskola tat-tifel/tifla tagħkom. Bħalissa qiegħda nagħmel Masters fl-Edukazzjoni Bikrija u fl-Edukazzjoni Primarja (Matematika) l-Università ta' Malta. Bħala parti mill-istudju tiegħi, se nagħmel riċerka bit-titlu: ''*Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project*'' taħt is-superviżjoni ta' Dr. Marie Therese Farrugia. L-għan ta' dan l-istudju hu li naħdem flimkien ma' erba' għalliema tal-Kindergarten biex nanalizzaw fil-fond it-tagħlim tal-matematika fil-kindergarten 2.

Parti minn dan l-istudju jirrikjedi li jien nidħol fil-klassi tat-tifel/tifla tiegħek waqt li l-għalliema tkun qed tagħmel l-attivitajiet tal- matematika. Waqt dawn l-attivitajiet, jien inkun qed nieħu xi noti dwar l-istrateġiji u r-riżorsi li jintużaw waqt it-tagħlim tal-matematika. Jista' jkun li jkolli bżonn nieħu xi noti dwar il-kontribuzzjoni tat-tifel/tifla tiegħek waqt l-attività u xi ritratti tax-xogħol tat-tifel/tifla tiegħek. Se tingħata attenzjoni biex ma jittieħdux ritratti li fihom j/tidher it-tifel/tifla tiegħek. In-noti u r-ritratti jistgħu jiġu użati bħala dejta. Dawn ikunu merfugħin f'post sigur u jien u s-supervisur tiegħi biss ikollna aċċess għaliha. Fit-teżi tiegħi se nuża ismijiet fittizji biex l-iskola u l-identità tal-għalliema tibqa` anonima. L-isem tat-tifel/tifla tiegħek se jibqa` anonimu. L-għalliema tal-klassi se tagħti spjegazzjoni lit-tfal tal-klassi dwar dan l-istudju u jien se nkun qed nikseb il-kunsens tat-tfal b'mod li jinftiehem mit-tifel/tifla tiegħek.

Il-Parteċipazzjoni f'dan l-istudju hija volontarja. Jekk inti ma tixtieqx lit-tifel/tifla tiegħek tieħu sehem f'dan l-istudju, it-tifel/tifla tiegħek xorta jipparteċipa fl-attività tal-matematika u jien ma nieħux noti dwaru/dwarha jew ritratti tax-xogħol tiegħu/tagħha. Int u t-tifel/tifla tiegħek tistgħu tibdlu il-ħsieb dwar il-parteċipazzjoni f'dan l-istudju mingħajr ma jkun hemm ebda konsegwenzi. Jekk inti tixtieq li nuża il-kontribuzzjoni tat-tifel/tifla tiegħek waqt l-attività, jekk jogħġbok imla il-formola tal-kunsens annessa u ibgħatha lura lill-għalliema fl-envelop provdut sa [Data].

Jekk tixtieq iktar informazzjoni jekk jogħġbok ikkuntattja lili jew is-surpevisur tiegħi.

Grazzi

Isem: Josette Grech
Indirizz Elettroniku: josette.grech.04@um.edu.mt
Numru tal-mobajl:99866304

Isem s-surpevisur: Dr. Marie Therese Farrugia
Indirizz Elettronikul: marie.t.farrugia@um.edu.mt
Numru tal-Uffiċju : 2340 2933

Ittra ta' kunsens mill-Ġenituri/Gwardjani għall-parteċipazzjoni tat-tfal

[Data]

Jien qrajt l-informazzjoni tal-Ġenituri/Gwardjani mehmuża. Jien nagħti l-kunsens biex it-tifel/tifla tiegħi j/tipparteċipa fl-istudju tas-Sinjura Josette Grech.

Nifhem li:

- Jien liberu li nirtira l-kunsens tiegħi fi kwalunkwe ħin matul l-istudju.
- It-tifel/tifla tiegħi se j/tintalab ukoll j/tagħti l-kunsens tiegħu/tagħha u huwa/hija liberu/a li j/tagħżel li j/tipparteċipa fl-istudju.
- In-noti meħuda se jinħażnu b'mod sigur u jkunu aċċessibbli biss għas-Sinjura Josette Grech u s-superviżur tagħha.
- L-iskola u l-identita` tal-għalliema se jkunu anonimi peress li s-Sinjura Josette Grech se tuża ismijiet fittizji fil-kitba tagħha.
- Isem it-tifel/tifla tiegħi mhux se jintuża fl-ebda kitba

_____	_____
Isem it-tifel/tifla	Isem il-Ġenitur/Gwardjan
_____	_____
Data	Firma tal-Ġenitur/Gwardjan

_____
Josette Grech
Email: josette.grech.04@um.edu.mt
Mobile number: 99866304

Appendix 13A

Spjegazzjoni mill-Edukaturi tal-Kindergarten lit-tfal

Tfal, Ms Grech l-Assistant Head tal-iskola se tiġi fil-klassi tagħna. Hi se tkun qiegħda magħna waqt li aħna nkunu qed nagħmlu xi attivitajiet tal-Maths. Ms Grech tixtieq tikteb xi noti dwar dak li tkunu qed tagħmlu waqt l-attività u tieħu xi ritratti tax-xogħol li tkunu qegħdin tagħmlu.

Se nagħtikom karta kull wieħed bħal din u l-kuluri (l-għalliema turi lit-tfal il-karta tal-kunsens). Fuqha għandkom żewġ uċuh. Wiċċ minnhom ferħan u l-wiċċ l-ieħor imdejjaq.

Jekk tridu li waqt l-attività tal-Maths, Ms Grech tikteb xi noti dwar dak li tkunu qed tagħmlu u tieħu xi ritratti tax-xogħol li tkunu qegħdin tagħmlu, pinġu bil-kulur il-wiċċ ferħan.

Jekk ma tridux li Ms Grech tikteb dwar dak li tkunu qed tagħmlu waqt l-attività u tieħu ritratti ta' dak li tkunu qed tagħmlu , pinġu l-wiċċ imdejjaq.

Explanation by the Kindergarten Educators to the students

Children, Ms Grech the Assistant Head, is coming to our classroom. She is going to be present during a number of Maths activities. Ms Grech would like to write notes about what you would be doing during the activity and also take photos of the work you would be doing.

I am going to give you a handout each like this, and colours (the teachers shows the assent form to the children). On it there are two faces. One face is happy and the other face is not happy.

If you would like Ms Grech to write notes about what you would be doing and you agree that she takes photos of the work you would be doing, colour the happy face.

If you do not want Ms Grech to write notes about what you would be doing and take photos of the work you would be doing, colour the unhappy face.

Appendix 13B

Students' Assent form

Integrating mathematical concepts and processes into children's learning experiences at Kindergarten 2 level: An Action Research project

Name _____

Class _____