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The Role of Direct Instruction and Playful Learning Pedagogies in Effective Mathematics Teaching.

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Supervised by Eddie Costello

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Abstract

In my research question I ask, “how can I enhance my teaching of mathematics by using a balance of direct instruction and playful learning pedagogical approaches?”. The rationale for this action research study stems from my personal value of providing high-quality teaching and learning in mathematics. As I reflected on my practice, I found myself struggling to balance a teacher-led direct instruction pedagogical approach while also upholding my values of providing active and playful learning experiences. My aim was to investigate if using a balance of these two, seemingly contrasting approaches, could work in harmony to enhance my teaching of mathematics.

The research took place in a vertical mainstream school with a sample of nineteen fourth class children aged nine and ten. I used an action research methodological approach and designed an intervention to teach a series of topics in mathematics using both playful learning and direct instruction. The topics taught included: 2D shapes, time, length, fractions, fractions and decimals and multiplication. I scaffolded new concepts and designed playful learning activities that would meet the learning needs of the children and engaged in dialogue with them about their experiences of both pedagogical approaches. Throughout the intervention data was collected using surveys, group interviews and personal reflections. This data was then analysed and three themes, playful learning, the role of the teacher and using a flexible approach, with associated findings emerged. The findings suggest that playful learning and direct instruction are effective pedagogical approaches to use in the senior primary classroom and that flexibly using a combination of both results in high-quality teaching and learning. As a result of the findings, I outline the implications for my personal practice and potential contribution to the wider Irish educational context such as curriculum development.

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List of Acronyms

CPD	Continuous Professional Development
EPV	Extra Personal Vacation
NCCA	National Council for Curriculum and Assessment
ZPD	Zone of Proximal Development
GRR	Gradual Release of Responsibility
NMAP	National Mathematics Advisory Panel (United States)
NRC	National Research Council (United States)
UNICEF	United Nations Children's Fund
UNCRC	United Nation's Convention on the Rights of the Child
DCYA	The Department of Children, Equality, Disability, Integration and Youth
UN	United Nations

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Chapter One: Introduction

1.1 Research Question and Rationale

In my research question I ask, “how can I improve my teaching of mathematics by using a balance of direct instruction and playful learning?”. I designed an intervention using a blend of pedagogical approaches to investigate if using a balance of direct instruction and playful learning could be an effective method of enhancing my teaching of mathematics in a senior primary classroom.

An action research approach was utilised as the research focuses on an analysis of my personal practice and the impact it had on teaching and learning. Using a self-study approach allowed me to keep the research relevant to my personal context. The research took place in my 4th class classroom in a medium size, vertical school in Ireland. Ireland has had a constructivist curriculum for quite a number of years (NCCA, 1999) and with the focus on child-centred learning there is less of an emphasis on the role of the teacher. As an educator who values providing high-quality learning experiences, I wanted to look at the role of the teacher in the classroom as I felt conflict between spending time in direct instruction and providing time for play in the senior classroom as direct instruction was not a methodology that was emphasised in the curriculum, despite being a critical part of my personal practice. I considered the quandary of balancing these two pedagogical approaches as I felt both were valuable teaching methodologies but was struggling to reconcile what I believed were two very different philosophies.

I reviewed relevant literature related to how children learn in mathematics to better understand the role of the teacher in the classroom with a focus on the pedagogical approaches of direct instruction and playful learning. My epistemological outlook involved

emphasising the children's voices and considering their experiences of both pedagogical approaches. My aim was to see how playful learning would work in conjunction with teacher-led direct instruction, with the intention of providing effective mathematics teaching by using a combination of both pedagogical approaches. The intervention was comprised of my teaching of various topics (see Section 3.10) using a blend of direct instruction and playful learning to investigate their effectiveness.

1.2 Personal Reflection

In this section I aim to contextualise this self-study action research project by describing myself as an educator. Understanding my 'self' will allow an insight into the choices and epistemological approaches taken throughout the research. I am an educator who strives to provide high-quality learning experiences for the children in my classroom. I have a passionate interest in teaching mathematics and in providing playful and active learning experiences. I have taught senior primary classes for the last ten years and strive to create engaging and child-centred resources in Mathematics, Irish and other subjects. In 2018, I created a business called 'Michelle's Innovative Ideas' and began to sell my teaching resources to teachers around the world. Moreover, I share practical teaching ideas and resources online on Instagram [1] where I have over eighteen thousand followers. As well as being a teacher, I am also a leader of learning through the creation of continuous professional development (CPD) for teachers. In 2020, I co-created a literacy summer course for teachers called 'The Literacy Masterclass' which was approved as an extra personal vacation (EPV)

[1] Instagram is a social media platform which allows people to share images and videos online. In January, 2022, Instagram had 2.6 million Irish users (Weckler, 2022) and many Irish teachers use Instagram as a means to share their ideas with other teachers.

certified course by the Department of Education. To date, over five hundred teachers have taken part in this course. Mathematics is an area of the curriculum I love to teach. I love the joy, curiosity and challenge it can bring in the classroom and I have been developing games to support teaching in mathematics over the past few years. As my intention was to improve my educational practice, I questioned if my approach to teaching mathematics was enhancing the learning experiences for the children in my classroom.

1.3 My Values

As part of this research, I spent time naming my values as an educator through engagement in a critically reflective process. Several key words emerged including high quality teaching, using active and playful learning, child voice, and relationships. From an epistemological perspective I value a child-centred approach where the children are active in their learning. I also value the role that the teacher plays in guiding and scaffolding learning. Fostering a learning environment which caters for all levels of ability and building relationships with my students are other key values I hold. Having named my values, I engaged in a process of questioning, narrating, and negotiating my personal and professional self-understanding (Kelchtermans, 2018). From examining my values, I questioned if I was teaching mathematics as effectively as I could. I noticed that I was struggling to reconcile two values; placing an emphasis on the teacher as having an important role in the classroom and simultaneously providing child led active learning. As I reflexively examined my reflective journal, I realised I was experiencing a living contradiction as described by Whitehead (1989). As well as valuing a playful child-centred approach I also value direct instruction and taking the time to explicitly teach concepts. As these seemed to be two contrasting epistemological visions of

education I decided investigate if using both direct instruction and playful learning in the classroom could contribute to an effective teaching and learning environment.

1.4 Action Research

Self-Study Action Research places the focus on the identity of the researcher, their values, and their actions (McNiff, 2002). Using an action research method allowed me to put the children at the heart of the research and research teaching pedagogies in line with my personal values as described in section 1.3 and illustrated in Appendix X. As McDonagh et al. (2019) suggest my own values are drawn upon to guide the process of action research.

1.5 Participants in the Study

I teach fourth class in a medium sized, vertical school with a current enrolment of 400 children. At the outset of the intervention on February 14th, 2022, I had twenty-one pupils and nineteen of these elected to participate in the research. By May 1st, 2022, I had twenty-six pupils, as five refugees from Ukraine[2] joined the class. As the research was focused on my teaching of mathematics, all children in the classroom took part in the mathematics lessons. However, data was only gathered from those who had given consent to participate. Further detail on participants, research background, ethical considerations and the intervention design will be discussed in chapter three.

[2] On February 24, 2022, Russia launched an invasion of Ukraine by land, air and sea. This led to the displacement of a large amount of the Ukrainian people, who fled their homes to avoid the conflict. By July 3rd, 2022, over 40,000 Ukrainian refugees had arrived in Ireland (Central Statistics Office, 2022). By April 25th, 2022, our school had 19 additional Ukrainian children, five of whom were in my 4th class.

1.6 Format of Study

A number of data collection methods were used in this study, including, a reflective journal, surveys, photographs and small group interviews with the children. The intervention took place over two key cycles. Cycle 1 took place from February 14th – April 1st, 2022, and Cycle 2 took place from April 25th – May 20th, 2022. Within each cycle a mini cycle of preparation to teach, teaching the topic and reflecting and adapting on the teaching occurred (see Section 3.11). As each topic covered in mathematics was different, a unique approach was needed to effectively teach each one. A brief overview of the intervention is provided in the next section and a more detailed description is provided in Section 3.13.

1.7 Overview of the Intervention

For each topic being taught, I considered how to use both interactive direct instruction and playful learning to optimise children's learning experiences. This involved careful consideration of what learning outcomes the children needed to learn and what activities would be best to help the children achieve the learning outcomes. I used assessment for learning to identify the children's prior knowledge to establish a starting point. I then designed games and activities that would help children to achieve the learning outcomes. Extension opportunities were outlined for high achievers who needed a greater challenge and additional support was planned for children who needed it. New concepts were explicitly taught to the children during direct instruction. The children were actively engaged in playful learning by playing games and working in pairs before consolidating their learning with independent activities. After teaching I reflected on the process and made adaptations where necessary. Data collection methods such as surveys and small group conversations were used

to gather the children's perspectives and a reflective journal was used to reflect upon my own experiences.

Initially, I believed it was important to have an element of direct instruction and playful learning in each lesson. In Cycle 1, I aimed to divide my lessons up into blocks to allow for direct instruction, playful learning, and independent work in each one. However, upon reflection during and after Cycle 1, I realised this was impractical. In Cycle 2, I had a more flexible approach and rather than using a block of time for each methodology, I chose the most appropriate strategy to meet the learning needs of the children during that topic. Hattie et al. (2017) describe this as "precision teaching" which they clarify as knowing which teaching methodology to use and when to use it. While I still used both direct instruction and playful learning, I was less rigid in my lesson structure. As a result, some lessons were wholly direct instruction, some were centred on play and other lessons incorporated both.

1.8 Research Findings

Three themes emerged from the thematic data analysis process (Braun & Clark, 2006) with a number of associated findings. The data suggests that playful learning and direct instruction are effective pedagogies to use with senior primary classes. Playful learning can be used to teach, extend and revise content, and it enhances children's motivation and engagement. Using direct instruction to explicitly teach topics and scaffolding and guiding children is effective in helping children achieve learning outcomes. I found that using a balance of these pedagogies was effective in my classroom this year. In a wider educational context, I found that many teachers feel they lack confidence in their teaching abilities and knowledge. The findings are discussed in detail in chapter four.

1.9 Potential Contribution of the Research

This research looks at using a balance of playful learning and direct instruction pedagogical approaches for teaching mathematics in a senior primary classroom. It is child-centred and evidence based. On a micro level I hope that the research will help me improve my teaching of mathematics and hope my students will benefit from my knowledge and approaches. On a macro level, I believe that this research could inform the National Council for Curriculum and Assessment (NCCA) in relation to curriculum development in mathematics. Moreover, I recommend that the methodologies of direct instruction and playful learning are shared as effective teaching strategies. I plan to share my experiences with others in a wider educational context through CPD courses for teachers.

1.10 Thesis Overview

Below is an outline of the key chapters and their contents.

The current chapter introduces the research question, describes the key focus and aims of the research, outlines the background context, gives an overview of the study and provides an outline of the chapters in this thesis.

The literature review in chapter two provides an in-depth exploration of literature relevant to the research question. It examines and defines the key concepts of direct instruction and playful learning as well as investigating wider issues in mathematics, including, how children learn and how teachers develop their conceptual understanding of mathematics.

Chapter three presents the rationale for choosing an action research approach. The research design and data collection methods are discussed in detail with reference to relevant literature. The key ethical considerations and ethical challenges are also discussed and the

intervention that took place in the classroom is described. In addition, the methods of data analysis are outlined and the limitations of the research considered.

The findings of the research are presented and discussed in the fourth chapter. This chapter includes the key findings that emerged from the research and a discussion of each finding in relation to relevant research.

In chapter five, key conclusions are reached and recommendations are outlined. The potential implications of the research are considered from my own perspective as well as the possible contribution of the study to the wider educational community and to curriculum development.

Chapter Two: Literature Review

2.1 Introduction

In my research question I ask, “how can I enhance my teaching of mathematics by using a balance of direct instruction and playful learning?” The two key components which are highlighted in this question are the role of the teacher in mathematics education and using playful learning as a methodology. The aim of this literature review is to define some of the key terms, such as direct instruction and playful learning, which are relevant to the research and to clarify the intent of the research underpinned by relevant literature. Relevant educational theorists are also examined to contextualise the epistemological views underpinning the research. My conceptual framework for the literature review is presented is illustrated in Figure 2.1 below.

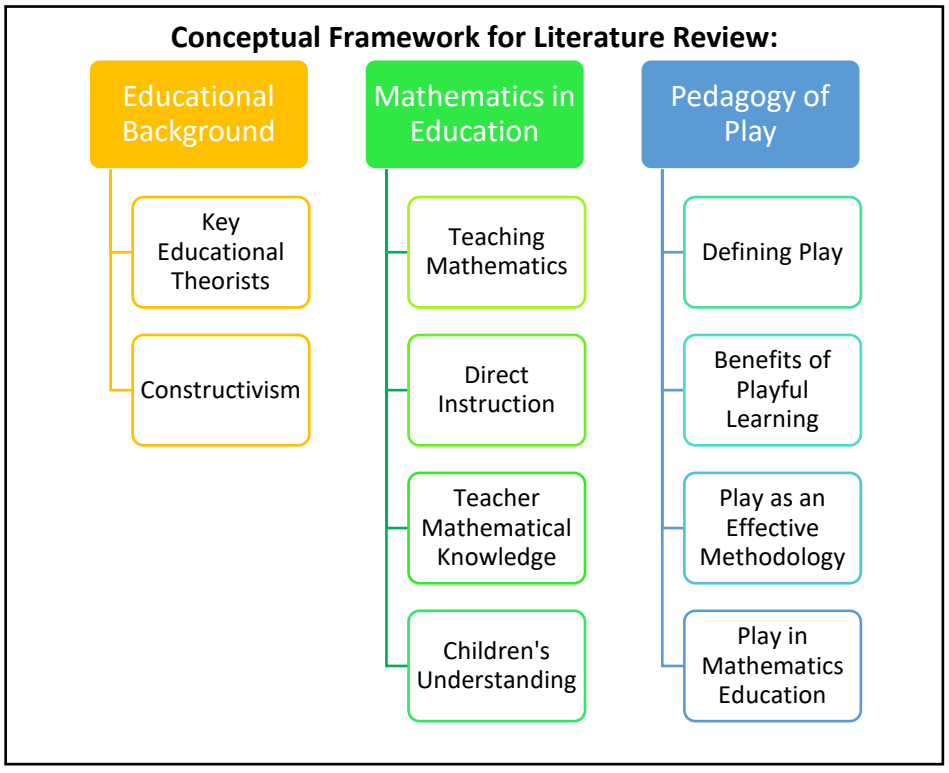


Figure 2.1: Conceptual Framework for Literature Review

As illustrated in Figure 2.1, initially I considered the educational background to the research and considered constructivist ideas based on the Irish constructivist approach and my personal values of child-centred learning. I investigated effective teaching in mathematics, the role of the teacher and the pedagogy of direct instruction to inform my intervention. In addition, I researched the pedagogy of play and the benefits of using playful learning as a methodology to teach mathematics. These topics create the background to the research and provide background knowledge upon which I can interpret and analyse the data emanating from my research.

2.2 Educational Theorists - Theoretical Background to the Research

As this research is based on two differing pedagogical approaches, the theory discussed in this section is used to inform my intervention design, understand the significance of different approaches and provide a platform upon which the research can be analysed. This research draws from key educational theorists, including, Froebel, (1887), Vygotsky (1967), Dewey (1938) and Piaget (1962). The ideas and principals of Friedrich Froebel (1887) are central to the ideas of playful learning and child-centredness that underpin this research. Likewise, Vygotsky (1967), Dewey (1938) and Piaget (1962) are central to an understanding of constructivism.

The two pedagogical approaches chosen in this research 'playful learning' and 'direct instruction' come from seemingly different theoretical backgrounds. Playful learning exists in the realm of constructivism whereas direct instruction is traditionally considered instructionist (Johnson, 2009). Considering the varying perspectives, I try to reconcile the two and suggest that by embracing elements of both constructivism and instructionism the teaching of mathematics can be enhanced. In this section I have primarily focused on a

constructivist approach, as I envision using a more child-centred approach to direct instruction which is further described in Section 2.3.3. Traditionally, instructionism refers to practices that are "teacher-focused, skill-based and product-orientated" (Johnson, 2009: 90) which suggests that instructionist approaches to instruction involves efficient movement of skills from the teacher to the child and the focus is on the teacher rather than the child.

2.2.1 Constructivism in Education

Constructivist ideas in education have existed for many decades and can be traced to writers such as Dewey (1938), Vygotsky (1967) and Piaget (1962). There are many ways to understand constructivist teaching (Duffy & Cunningham, 1996) and a full examination is beyond the scope of this study. Nevertheless, all constructivist approaches assume that knowledge is actively constructed by learners rather than absorbed passively (Johnson, 2009). When children's constructions are challenged, they engage in a sense-making process that generates learning (Piaget, 1977). Therefore, a constructivist teacher encourages participation by facilitating opportunities for students to discover knowledge (Baker & Baker, 2012).

Lev Vygotsky (1978), another constructivist theorist, described the zone of proximal development (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: 86). According to Vygotsky, when a child works in their ZPD, with the assistance of an adult or more experienced peer, they can participate in the environment in more complex and competent ways. The social dimension of working with others allows the

child to engage in more advanced cognitive activities than the child can undertake alone (Vygotsky, 1978).

According to Piaget's (1977) theory of cognitive development, humans gain intelligence through interactions and are in a continuous process of constructing mental schemata of how the world works from the ongoing changing nature of these interactions. Piaget defined a schema as the mental representation of an associated set of perceptions, ideas, and/or actions. Piaget considered schemata to be the basic building blocks of thinking (Woolfolk, 1987). The process of accommodation, according to Piaget's theory, involves altering one's existing schemata about how the world operates in response to new information and experiences. In contrast, assimilation seeks to relate new information to previously developed schemata. Piaget's contention is that to develop intelligence, humans must balance accommodation with assimilation.

A number of key links can be drawn between the ideologies represented by the aforementioned theorists. Both Vygotsky and Froebel highlight learning as a social construct. Similarly, both envisioned a role for an adult to act as a facilitator for learning. Vygotsky (1967) described a "more knowledgeable other" who would guide children. In this research the role of the teacher in leading learning in mathematics education is highlighted. The concept of providing teacher-led direct instruction while also having a constructivist learning environment is investigated, two seemingly contrasting perspectives. Other theorists such as Skemp (1976) and Shulman (1986) are drawn on to consider the knowledge teachers require to teach mathematics. Similarly, Kirschner, Sweller and Clark's (2006) perspectives on constructivist approaches are of significance considering a modern understanding of human cognitive architecture as described by Sweller (2011). These ideas are developed further in Section 2.3.3.

2.3 Mathematics in Education

In this section of the literature review I consider the purpose of mathematics education, the role of the teacher in mathematics education and the teacher knowledge that is necessary to teach mathematics effectively. This section will also clarify one of the key mathematical terms in my research question, namely, direct instruction. Firstly, I will position an understanding of mathematics in the Irish context by considering the current thinking on mathematics from the upcoming primary curriculum (NCCA, 2021).

In the United States, the National Mathematics Advisory Panel (NMAP) notes that teaching mathematics is an extraordinarily complex activity involving interactions among teachers, children and the mathematics to be learned in the classroom. It involves making choices about content, resources and planning ways to interact with children from different backgrounds with varied interests and motivations (NMAP, 2008).

A dichotomy exists in the field of mathematics pedagogy around the question of whether classroom instruction should be more 'teacher-directed' or 'child-centred' and the merits of a constructivist vs. instructionist approach. Schoenfeld (2004: 253) describes this schism as "math wars". Similarly, the NMAP (2008) described it as 'a controversial issue'. Both 'teacher-directed' and 'child-centred' instruction can be used as "labels to stake out starkly contrasting views in discussions about mathematics teaching" (NMAP, 2008: 6-11). These opposing views form the basis of the math wars described by Schoenfeld (2004). When considered from an extreme viewpoint, 'teacher-directed' can be described as teachers who present content without regard to the learners in their classroom. In the past it has been described as a "chalk and talk" approach (Muijs & Reynolds, 2000: 299) or where the teacher is a "sage on the stage" (NMAP, 208: 6-11) where the children are viewed as empty vessels to be filled (Freire, 1921). Similarly, 'child-centred' learning can be interpreted in an extreme

way to mean that the children control the direction and content of the mathematics discussion or that the children are expected to "somehow learn mathematics on their own, by teaching one another" (NMAP, 2008: 6-11). While these are extreme interpretations, both have been embraced by different groups over the past hundred years (Schoenfeld, 2004).

Schoenfeld, (2004) suggests a 'middle ground' or a combination of both pedagogical approaches may be the most effective approach. Both pedagogical approaches have valid and effective aspects when they are not viewed from as an extreme, either-or approach. It seems reasonable that using elements of both could be effective.

The Irish curriculum is heavily influenced by an American report entitled 'Adding it up' (National Research Council (NRC), 2001). This document describes the debates between the two aforementioned approaches to teaching as making "rhetoric distinctions that often miss the point regarding the quality of instruction". Despite this, recent Irish curricula (NCCA, 1999; NCCA, 2022) are purely constructivist in nature and as such do not describe the role of the teacher in providing direct instruction. A review of research by the NMAP (2008) suggests that high quality research does not support the contention that instruction should be entirely "child-centred" or "teacher-directed" and that the exclusive use of either approach is not recommended. By choosing the correct pedagogical approach to suit the learning needs of the class, teachers can best meet the needs of the learners in their classroom. As mentioned previously, Hattie et al. (2017: 26) describes this concept as precision teaching; "knowing *what* strategies to implement *when* for maximum impact is what we think of as precision teaching".

2.3.1 Teaching Mathematics

In this section I investigate the rationale behind teaching mathematics. The United States National Research Council (NRC) describe mathematics as "one of humanity's great achievements" (NRC, 2001: 1). We teach mathematics because it provides opportunities for developing important life skills and introduces children to key thinking strategies for solving problems, provides opportunities to use reasoning skills, organise data, be creative and to communicate (Haylock, 2019).

In Ireland, a new mathematics curriculum is currently being developed and a draft specification has been published (NCCA, 2022). The rationale for this upcoming mathematics curriculum states that "mathematics greatly enhances our capacity to understand and engage fully with the world around us" (NCCA, 2022: 9). The newly developed Irish mathematics curriculum emphasises that children should be encouraged to have a positive disposition to mathematics and asserts that enabling children as mathematicians lays the foundations for children to become confident and life-long learners (NCCA, 2022). Another rationale for the teaching of mathematics is the aesthetic aim that it is "beautiful and worthy of pursuit in its own right" (NCCA, 2022: 10). This idea is corroborated by Haylock (2019: 18) who describes mathematics as having "inherent beauty that can provide the learner with delight and enjoyment… there is potential for genuine enjoyment and pleasure for children in primary school in exploring and learning mathematics". The rationale for the Primary Mathematics curriculum includes five key statements: Every child is a mathematician; Mathematics is both a human and social phenomenon; Mathematics is a tool that helps us to make sense of our world; Mathematics is beautiful and worthy of pursuit in its own right and Mathematics is everywhere and for everyone (NCCA, 2022).

2.3.2 Effective Teaching in Mathematics

As the teaching of mathematics is an "extraordinarily complex activity" (NMAP, 2008: 6-xiii), a multifaceted answer is needed to explain what effective teaching in mathematics will look like. Excellence in mathematics teaching is a key aim of this research so I feel it is essential to extrapolate key elements from the literature that need to be present to ensure that high-quality teaching and learning occurs.

Muijs and Reynolds (2000) suggest three components of effective math teaching: direct teacher instruction, using a varied and interactive style and having a classroom climate where students are supported in their learning. Haylock (2010) explains that primary teachers must organise their lessons to provide careful, systematic and appropriate explanation of mathematical concepts, procedures and principles. He suggests that this is provided through having conversations, providing explanations, asking questions, allowing for practical engagement with mathematical materials and through exploration of concepts (Haylock, 2010). Likewise, Willingham (2009) suggests that teachers have a key role in helping children build cognitive connections between mathematical ideas. Rosenshine (2012: 12) also presents instructional principles of effective instruction which include teaching new material in manageable amounts through scaffolding, modelling, guiding student practice, checking for understanding, allowing time for independent practice and revising topics to ensure understanding.

2.3.3 Direct Instruction

Direct instruction is a key pedagogical approach in this research and is a complex instructional pedagogy. Rosenshine (2008) investigates several meanings of the term 'direct instruction', which is also known as direct teaching and explicit teaching in research. As direct

instruction can be framed as both a negative and positive instructional strategy (Rosenshine, 2008; Johnson, 2009) it is important to have a clear definition of direct instruction which is relevant to this study.

Hattie (2009) defines direct instruction as an intentional, well-planned, and child-centred scaffolded approach to teaching:

> In a nutshell, the teacher decides the learning intentions and success criteria, makes them transparent to the students, demonstrates them by modelling, evaluates if they understand what they have been told by checking for understanding, and re-tells them what they have been told by tying it all together with closure
>
> (Hattie, 2009: 206).

This interactive whole-class approach to direct teaching differs from a traditional, didactic approach where the teacher viewed students as vessels to be filled with knowledge (Freire, 1921) and where rote learning of procedures and a silent classroom were commonplace (Rosenshine, 2008).

Instead, a more constructivist view of direct instruction calls for the teacher to involve the children in the learning as co-constructors of knowledge where teachers use a varied teaching approach to keep children engaged (Hattie et al., 2017). Children have an opportunity to contribute to a dialogue and teachers ask questions (Rosenshine, 2008). In direct instruction, the children are not passive recipients of knowledge, but rather they are involved in listening to explanations and answering questions (Haylock, 2000). Despite this the teacher continues to play a central role in teaching and sharing new knowledge.

Kirschner, Sweller and Clark (2006: 75) suggest a further definition of direct instruction as instruction that provides “information that fully explains the concepts and procedures that students are required to learn as well as learning strategy support that is compatible with human cognitive architecture”. They note that while the constructivist description of learning

is accurate in that learners construct their own knowledge, the instructional design many constructivists use, where the children are asked to discover ideas for themselves with little guidance, seem to be ineffective. They note that minimally guided instruction is likely to be ineffective based on current knowledge of human cognitive architecture. They contend that:

> The past half-century of empirical research on this issue has provided overwhelming and unambiguous evidence that minimal guidance during instruction is significantly less effective and efficient than guidance specifically designed to support the cognitive processing necessary for learning.
>
> (Kirschner et al., 2006: 76).

This highlights the need for the teacher to provide specific guidance to children. Shulman (1986: 9) described the content knowledge and pedagogical content required by teachers and highlights that there is a distinction between the knowledge a teacher needs of the subject matter and the pedagogical knowledge they need to teach it. This is a fundamental element of direct instruction as the teacher is leading the learning and needs to have the knowledge to do so effectively, a concept which will be further elaborated on in Section 2.3.4. Kirschner et al. (2006: 79) note that 'controlled experiments almost uniformly indicated that when dealing with novel information, learners should be explicitly shown what to do and how to do it.' This is in direct contrast to a purely constructivist approach where children are expected to generate their own ideas and concepts. Research suggests that direct instruction including guidance, and demonstrating examples resulted in "vastly more learning than discovery" (Kirschner et al., 2006: 79).

Cognitive load theory, a theory which assumes that knowledge can be divided into primary knowledge we have evolved to acquire and secondary knowledge that is important for cultural reasons, such as mathematics (Sweller 2011), suggests that using a constructivist

approach where children are responsible for figuring out concepts without guidance generates a heavy working memory load that is detrimental to learning (Kirschner et al., 2006: 80). As children are using their working memory they are not as efficient in transferring knowledge to their long-term memory which impacts their potential for learning. Cognitive load theory supports the idea of the gradual release of responsibility model (GRR) (Pearson & Gallagher, 1983). The GRR is an approach which supports both direct instruction and child-centred learning as the teacher moves from demonstrating, to scaffolding and then to supporting as the children lead the learning. Sweller (2011) describes this as guidance fading. As the novice grows in expertise the need for worked examples is reduced and can be eventually eliminated. Having more knowledge allows for a reduced intrinsic cognitive load.

Sweller recommends that "we should never ignore human cognitive architecture when designing instruction" (2011: 74). Given that we now have a greater understanding of how the human brain works, disregarding direct instruction as an ineffective methodology is not best practice. Kirschner et al. note that purely "constructivist views have become ideological" (2006: 84) and resultingly, I suggest that direct instruction, as an effective teaching methodology, can be conceptualised as existing and working in harmony with a constructivist approach which understands that children can activity construct knowledge themselves. By viewing direct instruction as an interactive process where children are involved in their learning it has moved from a traditional, instructionist approach to one which works in a constructivist classroom. In this interactive vision of direct instruction, the teacher shares explicit information and scaffolds learning while valuing child voice and participation. The arguments presented in this section suggest that using a combination of instructionist and constructivist approaches may provide an effective teaching strategy, a contention which is backed by the NMAP (2008).

2.3.4 Teacher Mathematical Knowledge

As previously noted, the role of the teacher in mathematics education is a central theme underpinning my research. From the literature it is evident that teacher knowledge, their conceptual understanding of mathematics, and their approach to teaching mathematics concepts have a significant impact on children's learning (Haylock, 2010; Muijs & Reynolds, 2000; Kaskens, 2020; Skemp, 1976; Willingham, 2009; Kirschner et al., 2006; Hattie, 2017). As evidenced numerous researchers have considered the effect that teachers' pedagogical approaches and personal knowledge have on students in mathematics education. These perspectives are elaborated on in this section.

Teachers require an empowering pedagogical understanding combined with excellent curriculum content knowledge and a high expectation of students to teach mathematics effectively (Brough & Calder, 2012). Additionally, Kaskens (2020) found that teacher characteristics and competencies can influence students' achievement in mathematics. Likewise, Van der Grift (2007) found several teacher variables which have an impact on children's achievement. These include, having a safe and stimulating learning climate, clear instruction, effective teaching and learning strategies, classroom management and differentiation. Murphy et al. (2011) state that teaching mathematics effectively requires the teacher possess the content and pedagogical knowledge necessary. They suggest that is critical that both newly qualified and experienced teachers continually work to strengthen their mathematical knowledge (Murphy et. al 2011: 39).

Teacher knowledge is the foundation upon which pedagogy rests. Shulman (1986) proposes the content knowledge that teachers need to teach mathematics and describes content knowledge unique to teaching mathematics which he termed pedagogical content knowledge. Ball et al. (2008) identify three domains of content knowledge that teachers need

to be able to teach mathematics effectively: common content knowledge, specialised content knowledge and knowledge of teaching and learning. Common content knowledge is mathematical knowledge and skill used in settings other than teaching and includes the ability to correctly solve mathematical problems and use mathematical terms and notation correctly. Specialised content knowledge is mathematical knowledge and skill unique to teaching and includes a knowledge of mathematics beyond what is taught to children and an ability to unpack mathematical problems to make features of content visible to and learnable by students. Knowledge of content and teaching is a combination of knowing about teaching and knowing about mathematics. It involves having an ability to coordinate between the mathematical concepts and the instructional options. Teachers need specific knowledge to make instructional decisions such as pausing for clarification, making a mathematical point, asking a question or moving to a new task (Ball et. al, 2008). The researchers also suggest that horizon content knowledge is another essential component of teacher content knowledge. Horizon content knowledge is an awareness of how mathematical topics are related over the span of mathematics in the curriculum. This allows the teacher to make connections to later mathematical knowledge and to build on children's prior knowledge (Ball et al., 2008; Willingham, 2009). Ball et al. (2008) proposed the diagram in Figure 2.2 to show the correspondence between their research and Shulman's original categories of content knowledge for teaching: subject matter knowledge and pedagogical content knowledge. This diagram illustrates the range of knowledge that teachers need to be able to teach effectively.

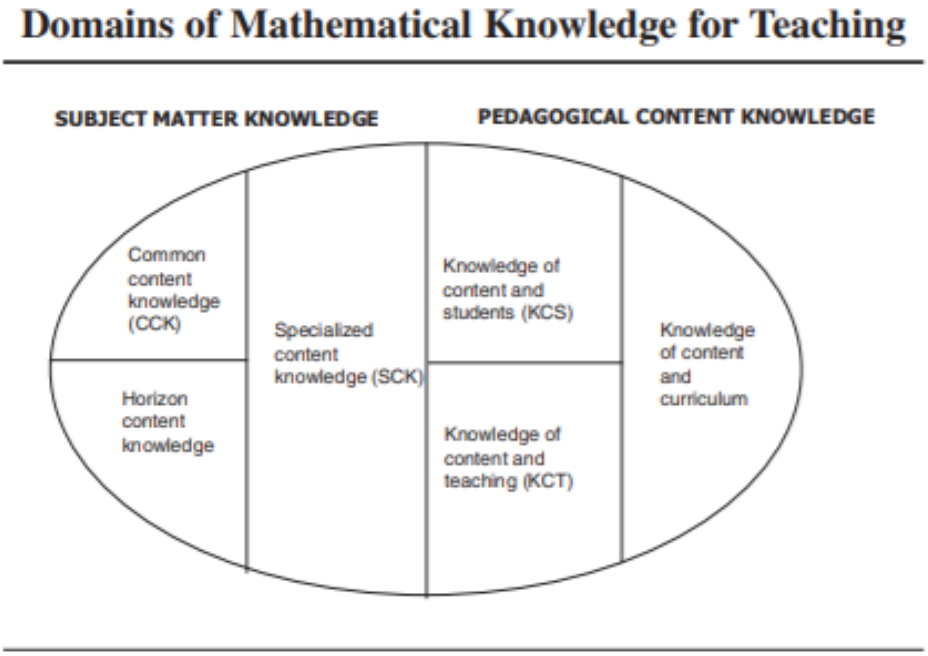


Figure 2.2: Domains of Mathematical Knowledge
Source: Ball et al. (2008) adapted from Shulman (1986)

Furthermore, Murphy et al. (2011) suggest that teachers who possess robust mathematical knowledge for teaching and demonstrate a higher quality of mathematical instruction are more able to differentiate for a variety of learning needs. Such teachers are also more effective at noticing and correcting student misconceptions. Ball et al. (2008) corroborate this point and suggest that explaining mathematical ideas is central to teaching, whatever the approach or style. Likewise, Rosenshine (2012) highlights the importance of checking for understanding and providing opportunities to review learning. These arguments highlight the importance of teacher knowledge in mathematics education.

2.3.5 Children's Understanding of Mathematics

Effective teaching of mathematics directly corresponds to children's understanding of mathematics. As such it is important to consider how children learn in mathematics. Although children have a natural number sense that allows them to understand number,

their abilities need to be cultivated to allow their mathematical proficiency to grow as they build their knowledge base (Willingham, 2009). New concepts must build upon something that children already know (Piaget, 1962). Children's conceptual understanding becomes key as concepts increase in difficulty. New knowledge must be linked to students' prior knowledge and mathematical ideas must be linked and not taught in isolation (Muijs & Reynolds, 2000). Conceptional knowledge is difficult for children to acquire. Willingham asserts that "a teacher cannot pour concepts directly into students' heads. Rather new concepts must build upon something students already know" (2009: 18). The role of the teacher is key in helping children to establish this knowledge base of mathematical foundations on which further understanding can be developed. This is reinforced by Kaskens who purports that teachers should be more aware of the "crucial role" they play in establishing a solid base for children to build their learning on (2020: 11). As previously discussed in relation to the concept of horizon knowledge, teachers' knowledge of the curriculum is essential (Ball et al. 2008). Murphy et al., (2011) conclude that teachers require both content and pedagogical knowledge to ensure students proficiency in mathematics. They state that the magnitude of the effect of teacher knowledge on student achievement is comparable to the effect of student characteristics such as absence rate, race/ethnicity and socioeconomic status. As such it is clear that teacher knowledge is of vital importance when aiming to provide high-quality teaching and learning experiences and thus relevant to this research.

2.4 Pedagogy of Play

In this section several perspectives on play are considered. Initially, several definitions of play are explored to provide a background context to using a pedagogy of play. These are then

compared to a recent definition by Zosh et al., (2017) and the vision of play used in this research is outlined. Moreover, the concept of playful learning and play as a spectrum are examined. In addition, the importance of play and its benefits for children are outlined before playful learning as a methodology is described. In the final section play as a methodology in relation to mathematics education is considered.

2.4.1 Defining Play

Play is an extremely complex concept despite being a human experience (Eberle, 2014). It has been researched and discussed by many theorists and researchers, each of whom conceptualised play with different definitions. (Froebel, 1896; Vygotsky, 1967; Piaget, 1962; Garvey, 1990; Brown 2010; Zosh et al. 2018; Eberle, 2014) As such, there are several definitions of play which merit discussion and are outlined below. Play is central to a constructivist and child-centred approach as previously described in Section 2.2. During play children play an active role in their own learning, and many of the theorists whose ideas were outlined in relation to constructivism in Section 2.2 are mentioned again in this section with regards to their perspectives on play (Froebel, 1896; Vygotsky 1967; Piaget, 1962).

For Froebel (1896), play was at the heart of learning. He believed that all areas of development could be promoted through play, from physical to social or intellectual development.

> Play is the purest, most spiritual activity of man at this stage, and, at the same time, typical of human life as a whole – of the inner hidden natural life in man and all things. It gives, therefore, joy, freedom, contentment, inner and outer rest, peace with the world It holds the source of all that is good…play at this time [childhood] is of deep significance…
>
> (Froebel, 1887: 55)

Froebel saw children as active, curious, creative learners who learn best through activity, play, talk and self-reflection and viewed play as child-initiated and child-led (Tovey, 2017).

Vygotsky (1967) elucidated that through sociodramatic play, children's cognitive development and mental functions are enhanced as they navigate through play and operate within the zone of proximal development. Piaget (1962), however, focused on play for its own sake and conceptualized play as the way that children understood the world to match their own concepts rather than to learn something new. Garvey (1990) describes play as being enjoyable, having no extrinsic goals, being spontaneous, involving engagement, and related to cognitive and social functions that exist outside of play. Brown (2010) argues that play is evolutionary and has the following properties: It is apparently purposeless, voluntary, inherently attractive making one feel good, allows freedom from time, diminished consciousness of self, improvisational potential, and continuation desire.

Some of the commonalities of many of these definitions include that play should be inherently child led and have no extrinsic goals. These definitions seem to focus on free play and agentic choice. However, like Zosh et al. (2018), I questioned if these definitions of play were broad enough to fully encompass everything that play is. The aforementioned definitions do not take into account games such as board games which have rules to follow, or games where there is a learning intention. I questioned if children are following rules and have a goal are they no longer engaged in 'play'? In these definitions play is conceptualised as belonging in the realm of early childhood. This is also evidenced in the Aistear curriculum framework (NCCA, 2009) which is aimed at children from birth to six years. Play and hands-on experiences are described as a way in which:

> children explore social, physical and imaginary worlds. These experiences help them to manage their feelings, develop as thinkers and language users,

> develop socially, be creative and imaginative, and lay the foundations for becoming effective communicators and learners
>
> (NCCA, 2009: 11)

However, I sought a wider definition of play to encapsulate a methodology of playful learning and play that was also suited to older children which would suit the playfulness experienced by the nine and ten year old children in my fourth class. I agree with Eberle (2014) who stated that play has resisted definition because of its complexity. He describes play as "an ancient, voluntary, 'emergent' process driven by pleasure that yet strengthens our muscles, instructs our social skills, tempers and deepens our positive emotions, and enables a state of balance that leaves us poised to play some more" (2014: 231). Eberle considers play beyond an ageist view that play exists only in the early years and suggests that play "offers a mix of physical, social, emotional, and intellectual rewards at all stages of life" (2014: 317). Similarly, Brown (2009) explains that as the human brain is neotenous, having the ability to generate new neurons throughout our lives, we retain the ability to play. "Our biology designed us for play throughout the life cycle. We play when we're young, and we're still able to play when we're old …we are neotenous—we retain that juvenile ability to play. I've seen people on their death beds still playing" (Brown, 2009: 405). It is evident that play is not just for the very youngest in our classrooms but instead can be used as a methodology for learning throughout primary school and beyond.

2.4.2 A Continuum of Play

Zosh et al. (2018) argue that many understandings of play are not nuanced enough. Rather than having a limited definition of play they suggest that play "may take many different forms and serve many different functions" (Zosh et al., 2018: 2). They envision play as existing along a continuum which ranges from free play to playful instruction. This is described as a

"multidimensional definition of play that creates a spectrum of play opportunities from free play through guided play to games and then playful direct instruction" (Zosh et al., 2018: 9). The rationale for envisioning play as existing along a spectrum allows for free play which is often hailed as the "gold standard" of play to be valued while also placing value on other forms of play including guided play, games and playful instruction. The term playful learning is an umbrella term that is used to include free play as well as more structured, guided play contexts. This challenges the previous, more limited views of play presented in Section 2.4.1 and suggests that a broader definition is required to capture the many varied elements of play. Figure 2.3 below captures the expansive nature of this definition of playful learning by Zosh et al. (2017), to include both child-led and adult designed play. At one end of the continuum free play gives children the freedom to explore, play, and discover with minimal constraints. At the other end of the continuum is play that is more guided, game-based learning and playful instruction (Zosh et al., 2017). This approach correlates with the Froebelian principal of freedom, where the adult guides children in their play, opens up possibilities and helps children develop autonomy and self-discipline within a framework of respect for others (Froebel, 1887).

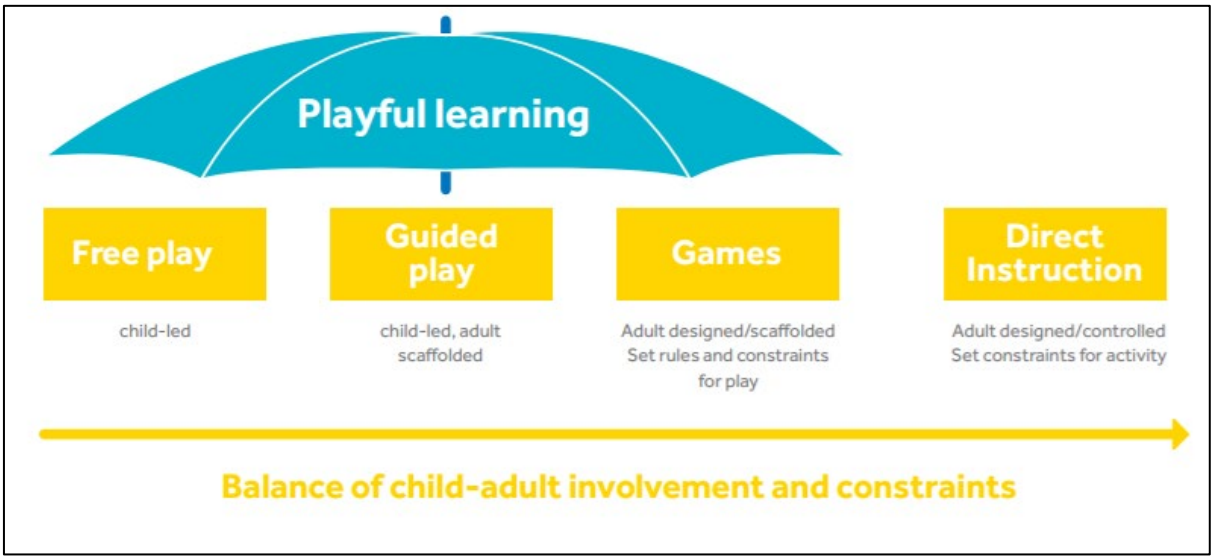


Figure 2.3: Continuum of Play
Source: Zosh et al., 2017

2.4.3 Benefits of Playful Learning as a Methodology

In this section I outline the rationale behind choosing play as a pedagogical approach in the senior classrooms. Evidence from a range of sources suggests that play and playful learning support children's learning (UNICEF, 2018; Solis et al., 2021; Zosh et al., 2017; Hirsh-Pasek et al., 2003). Play can have a key role in fostering creativity, imagination, motivation and cultivating interest in learning (UNICEF, 2018). It is widely regarded as one of the most important ways in which children gain knowledge and skills. The evidence is clear; for children play and learning are inextricably combined (Solis et al., 2021). Play can be joyful, meaningful, actively engaging, iterative and socially interactive (Zosh et al., 2017). Active, play-based learning approaches can transform the educational experiences of children and strengthen learning, motivation, and outcomes (UNICEF, 2018). The importance of play is recognised as a specific right for children by the United Nations (UN, 1989). Play also provides a great motivation for children and cultivates interest while helping them learn. Zosh et al. (2016: 48) contend that play-based learning is an instructional approach that "can help children not only to learn but to enjoy learning as well".

During play children try new things, solve problems, invent, create, test ideas, and explore (Hirsh-Pasek et al., 2003). Play satisfies a basic human need to express imagination, curiosity and creativity, which are key resources in a knowledge-driven world. Play helps children to cope, to find pleasure, and to use their imaginative and innovative powers (UNICEF, 2018). Hirsh-Pasek and Golinkoff (2008: 5) suggest that future success for children will depend on them having a "toolkit of skills that include collaboration (teamwork, social competence), content (e.g., reading, math, science, history), communication (oral and written), creative innovation, and confidence (taking risks and learning from failure)." They contend that each of these "Five Cs" is nurtured in playful learning (Hirsh-Pasek & Golinkoff, 2008: 5).

2.4.4 Adults' Role in Facilitating Playful Learning.

The United Nations Children's Fund (UNICEF) (2018) suggest that adults have a key role in facilitating playful learning from free play to structured games. They suggest that adults can recognise, initiate, guide and scaffold playful learning experiences while also supporting children's agency. This is mirrored in a Froebelian approach to teaching where children are provided with playful experiences but are guided by an adult (Tovey, 2017). Similarly, playful learning builds on the Vygotskian model of scaffolding as previously described in Section 2.2 (Vygotsky, 1967). The teacher guides the learning and provides encouragement and feedback on children's learning (Martlew et al., 2011). During playful learning in the classroom teachers provide important guidance and instruction. Free play is often the type of play that is first thought of by teachers when using play as a methodology is suggested. However, for play to be effective as a methodology to further learning, especially in the context of the senior primary classroom, it needs to be situated in a context which will support and further the children's learning. While free play allows children to be agentic in their learning (UNICEF, 2018) it may not provide children opportunities to extend their mathematical knowledge, especially in the senior primary classroom. The environment needs structure and boundaries to cultivate a positive disposition towards learning in mathematics. Moreover, teacher behaviour plays a huge role in ensuring children are cognitively challenged and learning during play-based learning (Mardell, 2021).

2.4.5 Limitations to Using Playful Learning in the Classroom

Play is limited by a number of external factors, especially when considering the classroom context. The physical environment structures play, as do the other people involved in the playful learning (peers and teachers) (UNICEF, 2018). Moreover, play in the classroom is

constrained by other factors, including, availability of resources, class size and the classroom space. Misconceptions about the value of play continues to be a reason that play is not integrated into curriculum in many countries (UNICEF, 2018). Time spent on play can be viewed as "frivolous and that play opportunities take time away from 'true learning'" (UNICEF, 2018: 14). Furthermore, they suggest that these misconceptions can be caused by a lack of understanding about the benefits of play for children in education. A lack of teacher professional development is a further reason discussed as a limitation to using play. As teachers have not experienced teaching through play, they may lack confidence in implementing it in classrooms. This concept of teacher's personal experience impacting their teaching style is one also addressed by Hattie (2017). He suggests that we "may need to accept and understand that high-quality learning may require that we discard ineffective pedagogy that we may have experienced as learners of mathematics" (Hattie, 2017:14).

2.4.6 Play as an Effective Methodology in Mathematics Education

The continuum of play ranges from adult-led games to child-led free play. As previously discussed in Section 2.3.3 of this review, direct instruction plays an important role in the provision of quality mathematics education. However, this works best when used in collaboration with other methodologies (Muijs & Reynolds, 2000). The research from theorists suggests that in the classroom, guided play is an effective strategy to enhance teaching and learning (Zosh et. al. 2016; Mardell et al., 2021; Solis, 2021; Hirsh-Pasek & Folinkoff, 2008; Liu et al., 2017).

Bergen (2018) states that playful learning provides an excellent environment for fostering young children's cognitive development, especially for those thinking skills essential for cognitive depth. As children learn through purposeful, quality play experiences, they build

critical basic skills for cognitive development and academic achievement. An emphasis on play is reflected in the draft Irish mathematics curriculum, albeit only in junior and senior infants, where the prefix of each objective is "through appropriately playful learning experiences, children should be able to…" (NCCA, 2022). I contend that there is also a place for playful learning as a methodology in senior classes, a perspective which is backed by the research outlined previously in Section 2.4.2.

Zosh et al. (2016) suggest that guided play during mathematics has been shown to be more effective than either free play or direct instruction. They describe a study by Fisher et al. (2013) where free play, guided play and didactic instruction were used to teach about shapes. It found that children who partook in guided play learned more about shapes than those participating in didactic instruction or free play. When children were asked to extend their knowledge of shape properties to atypical shapes, children who learned through guided play exceeded those who learned through didactic instruction by over 30% and by those in the free play condition by about 55%. This shows the impact that scaffolded, guided play can have on children's learning. I suggest that by having a balance of interactive direct instruction and playful learning activities led by the teacher will build upon these findings and show a positive impact on the learning in my classroom.

Indeed, Kamii (2015) has demonstrated that various types of mathematical knowledge, such as numeracy, classification, and spatial/temporal relationship understanding can be fostered by children's playful interaction with materials and games that foster such knowledge. Play also provides a great motivation for children and cultivates interest while helping them learn. Zosh et al. (2016: 48) contend that play-based learning is an instructional approach that "can help children not only to learn but to enjoy learning as well". Playful learning may also have a positive impact on children's motivation in mathematics. "When games are merged with

mathematics content their playful, active and engaging components may increase children's motivation to learn" (Zosh et al., 2016). Holton et al. (2001) suggest that mathematical play can provide opportunities for students to develop their own ideas without experiencing the threat of failure which provides a foundation for mathematical learning.

2.4.7 Play and its Impact on Anxiety in Mathematics Education.

Mathematics anxiety refers to the feelings of fear and apprehension that many people experience when dealing with mathematics (Hunt & Maloney, 2022). Mathematics is a topic which often causes anxiety for both teachers and children for a variety of reasons. As play is generally motivating and joyful for children (Mardell et al., 2021) it could help to prevent mathematics anxiety.

Haylock (2010) explains that anxiety about mathematics and feelings of inadequacy are common amongst adults. Surprisingly, this is especially apparent in those with high academic qualifications who feel they should be more competent. Murphy et al. (2011) describe difficulties that trainee teachers had in completing and explaining basic problems. As previously discussed in Section 2.3.4, teachers need a unique skill set and knowledge to effectively teach mathematics (Shulman, 1986; Ball et al., 2008).

Mathematics is an area where both children and adults can feel anxiety. Parents can pass their own negative associations with mathematics to children (Muijs & Reynolds, 2000). Kaskens et al. (2020) note that if children have difficulties in mathematics in early school years, they can experience an increase in mathematics anxiety. Consequently, they may avoid learning in mathematics, thus having increasingly negative experiences which leads to further anxiety (Kaskens, 2020; Haylock, 2019). If children are experiencing mathematics anxiety the associated negative thoughts and feelings can a cause reduction in their cognitive

resources such as working memory which directly impacts their ability in mathematics (Hunt & Maloney, 2022).

A study by Alkan (2013) which looked at methodologies implemented by teachers to reduce mathematics anxiety reported that most teachers interviewed used games to support learning and reduce anxiety. The results showed that games were used for a variety of purposes, including, to share information, to interest them and to provide a break from learning. Alkan notes that games should be related to learning outcomes to be most effective.

Playful learning, by its very nature, is joyful, meaningful and actively engaging. Furthermore, it is socially interactive (Mardell et al., 2021). “Two of the most important things play can develop are interest and motivation” (UNICEF, 2018: 10). Through providing opportunities for play children are supported to learn in an environment which will help alleviate anxiety in mathematics. As playful learning experiences “foster creativity and imagination which are critical components in enabling us to cope and to find pleasure” (UNICEF: 2018: 10) they can help children to navigate in situations which might have otherwise caused anxiety. As indicated above using playful learning as a methodology is an effective way to engage and interest children in mathematics education. As discussed, there is evidence to suggest that play could help alleviate anxiety children might feel about mathematics by helping them learn in a way that is child-centred and fun while still challenging them to think creatively.

2.5 Literature Review: Conclusion

This literature review encompasses a wide overview of topics relevant to the research. It establishes the theoretical background and considers significant topics in both mathematics

education and play which informed my research design and provided a platform to evaluate and interpret my data to develop themes and associated findings.

Considering the evidence presented in this section I can conclude that teachers' have a crucial role in facilitating children to develop knowledge in mathematics. The teacher plays a key role providing direct instruction and scaffolding learning (Kirschner et. al, 2006). From the literature it is evident that teachers' mathematical understanding and pedagogical knowledge will have a significant impact on the quality of the mathematics instruction (Shulman, 1986; Murphy et al., 2011; Ball et al., 2008). One of my key values which underpins this research is providing high-quality learning experiences for the children in my classroom and therefore my own knowledge and role in delivering direct instruction is important.

I contend that using elements of both constructivist child-centred and instructionist teacher-led approaches can be an effective means of teaching mathematics (Schoenfeld, 2004; Johnson, 2009; NMAP, 2008). Using a purely constructivist or instructionist approach has not been suggested as best practice (NMAP, 2008; NRC, 2001) and I concur with Schoenfeld (2004) who envisions that using elements of both approaches will be most effective. This is further backed up by the NMAP (2008: 6-xxiv) who recommend that practitioners recognise that a "deliberate and conscious mix of strategies will be needed and to design instruction that responds to children's strengths and weaknesses" and suggest that there is no one ideal approach to teaching mathematics. This information was used to design an intervention that uses both direct instruction and playful learning as key pedagogical approaches.

As evidenced in Section 2.3.3, I can determine that direct instruction is a valid and worthwhile pedagogical choice for mathematics instruction. Using a more child-centred approach to direct instruction where the voice of the child is valued and the explicit instruction is interactive (Hattie et al., 2017) is more in line with my epistemological view of child-centred

education than a traditional view of direct instruction. I suggest that this interactive direct instruction can work in tandem with a constructivist view of education.

In Section 2.4 I consider several definitions of play and envision play as existing along a spectrum (Zosh et al., 2018) and as being suitable for learners of any age (Brown, 2010; Eberle, 2014). As described in the literature the joyful, meaningful and actively engaging nature of play can support learning (Solis et al., 2021; Hirsh-Pasek & Hadani, 2020; Mardell et al., 2021) and as such play is a beneficial pedagogical approach.

The pedagogical approaches of play and direct instruction discussed in this chapter form the basis of my research intervention which is described in Section 3.10.

Chapter Three: Methodology

3.1 Introduction

This chapter is organised into a number of distinct sections. Initially, the rationale for using an action research paradigm is considered. Next, the research site and sampling methods are discussed. Following that, the ethical considerations including assent and consent, power dynamics, data storage and confidentiality and anonymity are described. The research design and cycles are described and an overview of the intervention is provided with specific examples of the activities used in the classroom. The concluding section of this chapter outlines the data analysis process.

3.2 Research Paradigm

A paradigm is a way of viewing the world; a framework from which to understand the human experience (Kuhn, 1962). In my research, an action research paradigm was adopted. This paradigm was most suitable as this research project has an emphasis on self-improvement in order to effect social change. Piggot-Irvine et al. (2015: 548) define action research as "a collaborative transformative approach with joint focus on rigorous data collection, knowledge generation, reflection and distinctive action/change elements that pursue practical solutions". In this case the aim is that the research will be used to examine the implications of direct instruction and playful learning pedagogies on my teaching and children's learning. The process of personal reflection will be integral to the research to inform and enrich my own practice.

Action research challenges the claims of a positivistic view of research which proports that to be credible research must remain objective and value-free (Brydon-Miller, 2003). Instead, the researcher embraces the concept that knowledge is socially constructed and places an emphasis on the relevance and validity of the research which is tested in action by key stakeholders (Sullivan et al., 2016). An action research approach is consistent with my epistemological value that knowledge is created through social interaction and dialogue. From a pedagogical perspective, I view the children as co-creators of knowledge. They play an active and vital role in their own education and as such an action research approach is an appropriate way to research my teaching of mathematics and children's experience of learning mathematics in the classroom appropriate in my context. In action research the power dynamic between researcher and participants shifts in comparison with traditional forms of research. The concept of power relations is further considered later in this chapter.

The idea of teacher as researcher arose from a body of research that established that teachers could analyse their own teaching by reflecting on their practice and becoming reflective practitioners (Schön, 1987). Kemmis and McTaggart (1982: 6) suggest that an approach is only action research when it is collaborative, and the research findings are formed through the "critically examined action of the individual group members". LaBoskey (2004) suggests that self-study has wider implications and that it involves interactions with colleagues, students and literature to confirm or challenge understandings. This suggests that self-study, while a study of the self, is also beneficial for others. In my estimation, a focus on the self is essential, to live to my personal values, especially my value of providing high-quality learning experiences as described in Section 1.3.

In my opinion, the transformative nature of self-study action research is one of its most essential components. Through greater self-awareness and self-refection, I aim to change my

practice to bring about an improvement. Studying the self leads to a reflective critique with a goal to enhance practice. This view is also purported by Kemmis (2009), who suggests that self-study provides teachers with the opportunity to study their practice with a view to improving and transforming it. My aim is to improve my own teaching of mathematics and to share the knowledge with others in my social context; the children in my classroom, my colleagues in the workplace and other Irish educators through providing CPD. As an educator my relationships with my students and colleagues are of vital importance. These relationships are reflected in my values of creating a supportive classroom environment with an emphasis on relationships. McNiff uses the terms "genuine sense of partnership" and a "creative dialogue of equals" to describe the relationships in a self-study action research approach (McNiff, 2002: 14) and I believe that self-study action research approach aligns with my values of building relationships and effective teaching and learning, allows for transformational thinking and involves the children as active co-constructors of knowledge.

Analogous to McNiff and Whitehead (2010), I hope that my action research study will improve my practice through a focus on critical self-reflection. It is evident that the focus on improving practice of both action research and self-study make them effective for an enquiry-based thesis which is focused on my practice. Similarly, as I hope to disseminate my research to my peers and colleagues in a wider educational setting, it is important to consider a broader view of mathematics education by consulting other teachers to find their perspectives on the role of the teacher and the use of playful learning in an Irish educational context.

As a passionate educator I believe that self-study is vital for growth. Pithouse et al. (2009) suggest that the very process of self-study itself changes its practitioner. I believe that change can be transformative and agree with Pithouse et al. who suggest that "knowing more about

ourselves as teachers and teacher educators changes us, provokes growth, jolts us out of complacency" (2009:7).

3.3 Action Research Cycles

McNiff and Whitehead's (2010) cycle of action research involves five key stages. These include identifying an area of practice to be investigated; imagining a solution; implementing the solution; evaluating the solution and changing practice in light of the evaluation. Whitehead (2017: 7) describes each action research cycle as "continuously evolving deepening and extension of insights", in both improving practice and in generating knowledge while being focused on improving practice.

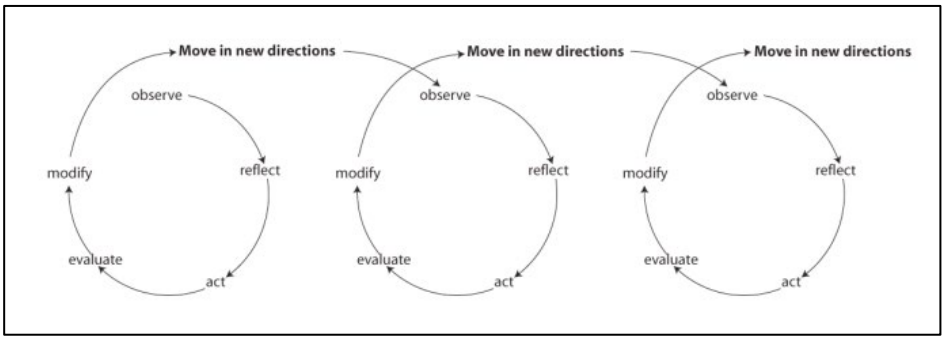


Figure 3.1: Action Research Cycles
Source: Yee, J. (based on McNiff and Whitehead 2006)

Action Research allows for theory generation, intervention and theory testing to co-exist in an iterative loop as depicted in Figure 3.1. This accurately describes the action research cycles undertaken in this research as there was a constant cycle of observing, adapting and trying new things. Throughout my research I was conscious of this iterative nature of action research and as such noticed that within each topic I covered in mathematics was a mini cycle of preparation, teaching, reflecting and making change. Moreover, I had two key action

research cycles as I reflected on my use of the pedagogies of direct instruction and playful learning and made changes to improve my practice (see Section 3.11).

3.4 Research Site

The research site is a medium size, co-educational primary school with approximately 400 children enrolled. There are sixteen mainstream classes and two additional classes for children with Autism. The school primarily enrols children from urban areas around the local town. A small percentage of children are from rural backgrounds. The school is welcoming and inclusive and has modern classrooms and spacious grounds. The staff are dedicated and hard-working and there is a positive atmosphere in the school. My role is as a mainstream classroom teacher, and I have taught at the senior end of the school for the past ten years. In addition, I am a member of the Droichead team which supports and mentors newly qualified teachers who join our school team. Most classrooms have children with a diverse range of needs. The children involved in the research are nineteen of the twenty-six children in my fourth-class setting. The children are aged nine and ten and are an enthusiastic group of learners. The atmosphere in the classroom is positive and the children are respectful of their peers and the school staff. There are differing levels of ability in relation to mathematics education from very able leaners to those who are experiencing significant difficulty. This is evident from the range of STen scores from their Sigma-T [3] results which range from a child with a STen of 2 and a percentile rank of 5% to a child with a STen of 10 and scoring in the 98th percentile. During the research, the class dynamic changed significantly with the

[3] The Sigma-T is a standardised assessment test used in Ireland to measure children's attainment in Mathematics. It produces a STen Score on a scale of 1 – 10, to indicate children's level of conceptual understanding within a bell curve with 1 indicating child is experiencing significant difficulty and 10 indicating exceptional understanding.

addition of five Ukrainian children to the class in April 2022. While the research continued with the nineteen original participants who had given their consent to participate, having a number of children with no English posed a challenge. Significant additional time was spent modelling and explaining in mathematics to these children. The changes placed considerable time pressures on me as a teacher and meant that many of the children in my class also moved into a supportive role when demonstrating and explaining games in mathematics. While the research was ongoing in April and May there were no additional supports in place for the new children. These factors made teaching mathematics and gathering data for the intervention more challenging as there were additional needs in the classroom.

3.5 Sampling

Convenience sampling was the chosen method of sampling for this research study. Cohen et al. describe convenience sampling as “those who happen to be available and accessible at the time” (2018: 218). The participants for my study were the children in my fourth class. In an educational context convenience sampling is a practical and effective strategy to use. Convenience sampling was used because access to the participants was readily available. All children were involved in the mathematics intervention regardless of their decision to participate in the study as it is a core curricular subject. The sample size of nineteen children was also a manageable one for me as a researcher as it was possible to talk to and engage with all children during the research. Moreover, convenience sampling maximized the validity of the findings by giving an equal chance to every individual to participate without being intentionally selected by the researcher (Farrokhi, 2012).

3.6 Ethical Considerations

My research approach ensured the children in this study were treated with respect and dignity, and to be regarded as co-researchers (Sullivan et al., 2016). The children played an essential role in describing their experiences during mathematics lessons and discussing the role of the teacher and the games and activities used. There are a number of key ethical concerns which could potentially arise as a result of the research as I was working with a vulnerable group; children under the age of eighteen. Some of the key ethical issues to consider are consent and assent, minimising the risk of harm, ensuring confidentiality and anonymity, power dynamics and data storage. These are discussed in detail in the upcoming paragraphs. All research was carried out in accordance with articles three and twelve of the United Nations Convention on the Rights of the Child (UNCRC) and the best interest of children was "a primary consideration" at all times (UNCRC, 1989).

3.6.1 Assent and Consent

Cohen et al. (2018) suggest that four elements need to be present for informed consent: competence, voluntarism, full information, and comprehension. In my research I was cognisant in having these elements to allow for informed consent. All children in my class were given the choice to participate in the research and their role as valued co-researchers was clearly explained (Sullivan et al., 2016). Information about the research was discussed in a child accessible way and the aims, methodology and data collection were explained (DCYA, 2012). It was made explicitly clear to all children that their participation was completely voluntary, and they could withdraw their assent at any time. Before giving their assent to take part through completing an assent form, children were given time to assimilate the information, ask questions and discuss the research with their parents.

Parental consent was also required as the children are under the age of eighteen. Parents were provided with information (see Appendix I) about the study to allow them to make an informed decision. Children returned the completed assent and parental consent forms (see Appendix I) to the school and parents were welcome to email me with any further questions. Approval was also sought and received from the Board of Management for the research to take place (see Appendix II). Nineteen children returned the assent and consent forms. These children became the research participants and data was collected from them in the form of surveys and small group interviews.

3.6.2 Power Dynamics

As the researcher I was conscious of the power dynamics and relationships which might impact the children in the classroom. As the research took place in a whole class setting all children were welcome to participate. Care was taken to ensure that children who opted out were treated equally. Opting out of the research had no pedagogical impact on the children. It was explained that they would not be excluded from any of the activities in the classroom. As the research was carried out as part of our normal mathematics lessons, the two children who chose not to participate were still fully involved in classroom activities. However, data was not collected from these children.

As the teacher I also have a role of power in the classroom. I was conscious that children feel free to express genuine views and weren't afraid to share concerns or difficulties they experienced in the activities and with mathematics in general. As a teacher researcher I aimed to minimise the risks to children by employing a child-centred, inclusive approach (DYCA, 2011). I modelled sharing positive and negative thoughts about activities to show children that all comments were welcome. All surveys were carried out anonymously so

children could share their thoughts without being conscious of my opinion. Additionally, I used my values system as a guide and viewed students as agentic and able to form their own thoughts and ideas that are beneficial and worthwhile. From an epistemological perspective I considered the children to be co-participants who played an active role and provided valuable contributions to the research. I explained this role to the children and emphasised that I am working with them to learn more about my teaching, rather than doing research to or on them (Sullivan et al, 2016).

3.6.3 Confidentiality and Anonymity

Confidentiality and anonymity were essential to ensuring that data was ethically gathered. Confidentiality implies that research data that includes identifiable information on participants will not be disclosed to others without the consent of participants, except in the case of a child protection concern (DYCA, 2012). Anonymity is defined as the process of not disclosing the identity of research participants (Vainio, 2013). Anonymity is a way to apply confidentiality. Throughout the research as I gathered information from the children only the minimum amount of personal data was retained, as suggested by Sullivan et al. (2016). Before disseminating the findings of the research or sharing the data it was anonymised so that the children were not identifiable. Some data was gathered anonymously such as a Google Forms survey. Other data was not gathered anonymously as I kept records of assessment notes and observations of children to inform my practice, as is usual for a classroom teacher. This data was anonymised when shared as part of the research process. To preserve the anonymity of data I removed any direct identifiers, for example children's names on surveys, worksheets and in photographs of work. I used a pseudonym in the form of a letter (Child A, Child B…) to ensure individuals were not identifiable (DCYA, 2012; Sullivan

et al., 2016). While the name of the research site is not included in the research, the anonymity of the location is not guaranteed as it will be evident to anyone who knows the researcher.

3.6.4 Data Storage

Both digital and physical data will be stored in accordance with Maynooth University guidelines to ensure the ethical reliability of the study. The data will be stored for a period of six years in accordance with the Maynooth University research records retention schedule.

3.7 Research Strategy and Data Collection

Qualitative data was collected and analysed. Several key methods of data collection were utilised, namely surveys, group interviews and observations. I maintained a reflective journal, a key tenet of action research, which allowed me to be reflexive and critically reflect on my own learning as suggested by McNiff and Whitehead (2010). There are several purposes of qualitative research, for example, description, explanation, reporting, creation of key concepts, theory generation and testing (Cohen et al., 2018) and as such the data gathered allowed me to explain, describe and generate theory based on my research.

Furthermore, in an action research context researchers use methods which will "produce the needed evidence and context for understanding their practice" (Hamilton & Pinnegar, 1998: 240). The purpose of collecting data in this research was to generate evidence and to help me make sense of the information in relation to the literature. My methods of collecting data were influenced by my research question, my values and my pedagogical outlook. Several data collection instruments including surveys, group interviews and personal reflections

were used to ensure that data was collected authentically and in sufficient detail to generate evidence to support my claim to knowledge. Using a number of different data collection methods also allowed for triangulation as data from different sources was compared.

3.8 Data Collection Instruments

I considered a range of data collection instruments and chose a number which suited my context, and which were useful in providing valuable data in the context of my research. As discussed by Vanassche and Kelchtermans (2016) using qualitative approaches allowed me to articulate my understanding of teacher education practices. The data was gathered in collaboration with the children using written surveys and group interviews. Audio recordings were used to ensure validity and authenticity. Other data was collected solely by the researcher in the form of observational notes and a reflective journal. Photographs were taken throughout the data collection process as another method of recording the activities and to later analyse and reflect upon. To understand the perspectives of other educators in an Irish educational setting an online survey was also carried out to gather the experiences of other educators teaching mathematics in a senior primary classroom. The data collection instruments are described in more detail below.

3.8.1 Surveys

Two distinct types of surveys were used, children's surveys and a teacher survey, for different purposes. Children were surveyed as a means for them to share their thoughts on the pedagogical approaches being used (playful learning and direct instruction) and to describe their learning and their feelings during mathematics. This allowed me to examine the

research question from the perspective of the child (Brookfield, 2017) and provided valuable data in relation to the children's experiences of mathematics during the intervention. In addition to the children's survey, a teacher survey was carried out to gather data from other Irish teachers about their perspectives on mathematics education in the senior primary classroom. The survey was carried out on my Instagram page 'Michelle's Innovative Ideas', a method which was chosen as it allowed a large sample of teachers to partake. The survey was shared using the stories feature on Instagram and senior mainstream teachers had the option to opt-in to the survey by choosing to answer the questions. Participants had a twenty-four hour window to answer each of the questions, which could only be answered once. The survey was anonymous, and participants were informed that the purpose of the survey was to gather information and to inform my research. The survey was carried out on May 19th, 2022, and the question schedule and full results are in Appendix VIII. As described by Cohen et al. (2018) surveys provide an opportunity to describe existing conditions or to determine relationships between specific events. This survey provided valuable data in a wider Irish educational context and allowed me to relate my intervention to the practice of other Irish educators as well as allowing me to position my research in an Irish context regarding curriculum development given my role in providing information and CPD to teachers in Ireland.

3.8.2 Interviews

Interviews were carried out at two different points during the research and provided a useful way to collect data and authentic child voice in relation to the intervention, including the teaching methods and activities used within the intervention. This data was essential in helping me understand children's experiences of playful learning and direct instruction.

Interviews accord children agency and competency (Jansen, 2015). As the children were valued co-researchers who had valid contributions to make in terms of ideas, opinions, and experiences that I wished to understand, interviews were a pertinent means of data collection (Cohen et al., 2018: 528). Group interviews were used as a time-efficient means to talk to all children. Cohen et al. suggest that a group interview brings together "people with varied opinions or as a representative of different collectives" (Cohen et al., 2018: 527). As a researcher it was useful to talk to the children in groups to hear their different perspectives on the pedagogical approaches used. It was also a more manageable and practical approach for the classroom than individual interviews. One whole class interview was carried out at the start of the research and nine small group interviews were used at two different stages of the research. The transcripts of the small group interviews are available in Appendix V.

3.8.3 Unstructured Observations

Unstructured observations are particularly suited for an action research approach as the researcher can observe what is taking place before deciding on its significance for the research. It allowed me to gather data before hypothesis were created and was a suitable approach in the classroom as I continually observed and monitored the children as part of my normal teaching role. Notes from the observations were recorded in my reflective journal. Cohen et al. (2018) note that observation is a useful research tool which allows an opportunity to gather first-hand data from naturally occurring social situations and has the potential to yield more valid or authentic data than reported data or second-hand accounts. As the research was undertaken in the classroom using observations allowed me to gather data as the intervention was ongoing.

3.8.4 Reflective Journal

McDonagh et al. (2019) suggest reflective writing is key to a self-study action research project and reflection on practice and critical reflection are key elements of a self-study action research process. Reflection-in-action (Schön, 1983) occurs as you respond to events in your practice and having a reflective journal allows for these thoughts to be recorded. A reflective journal can "enhance the reflective process and emphasise the importance of critical thinking and dialogue" (Mc. Donagh et al., 2019: 57). One stimulus for reflection were the photographs which were taken as part of the lessons as these allowed me to visualise what had been happening at the moment. Other reflections occurred as I reflected on the day-to-day events and social interactions that happened throughout the intervention.

3.8.5 Photographs

Photographs formed another key component to the data gathering process. The use of photographs was explained to both parents and children and consent and assent was sought to take and use them. Photographs were taken as a snapshot in time showing the children engaged in different activities which allowed me to describe and analyse the pedagogical approaches of playful learning and direct instruction used throughout the intervention and to better understand my experiences and the children's experiences throughout the research. As Given (2008: 620) suggests, photographs provide a different insight into the research and "complement the spoken word and often enable a richer, more holistic understanding of research participants' worlds,".

3.9 Data Collection Schedule

The intervention began on February 14th, 2022, and concluded on May 20th 2022. Table 3.1 depicts the data gathering schedule which occurred throughout the research.

Cycle:	Data Collection Method:	Timeframe:
Cycle One **14th February – 1st April 2022**	Whole Class Interview	16th February 2022
	Teacher Observations	Weekly
	Photographs	Weekly
	Written Survey 1	1st April 2022
Cycle Two **25th April – 20th May 2022**	Small Group Interviews 1	29th April 2022
	Teacher Observations	Weekly
	Photographs	Weekly
	Written Survey 2	3rd May 2022
	Small Group Interviews 2	11th and 12th May 2022
	End of Intervention Survey	20th May 2022

Table 3.1: Data Collection Timeframe

3.10 Trustworthiness

A limitation of action research is the positionality of the researcher. As previously discussed, the researcher is central to the study and the research is based on my observations and thoughts. Winter (2002: 145) suggests that maintaining an authentic voice is a key tenet of action research and that 'authenticity' might be used as criteria to judge the value of action research. He states that: "a research report has 'authenticity'" when it gives direct expression to the "genuine voice", which "really belongs to those whose life-worlds are being described" (Winter, 2002, cited in Sullivan et al., 2016). This is especially important in an action research

context as the research is not replicable as it is highly individualised. In this research the voice of the child was shared in an authentic way through transcriptions of interview data, photographs and written surveys. Every effort was made to ensure a victory narrative was avoided (Sullivan et al., 2016) and the authentic voice of the child was conveyed as befitting their inclusion as collaborators and co-constructors of knowledge in the research.

To ensure credibility throughout the data collection process and analysis, I used a triangulation method. Sullivan et al. note that the researcher can triangulate their data by cross-checking work from a number of perspectives and "can explain more fully the richness and complexity of the changes you have made because they are viewed from more than one standpoint" (2016: 82). They suggest that seeking the opinion of others, such as critical friends, colleagues or peers who are also engaging in research can add triangulation to the data by adding a variety of perspectives. My critical friend listened to, questioned and discussed the intervention with me from its initiation in February to the analysis of data in July 2022. A variety of data collection methods were also used as previously discussed in Section 3.8 and a timeline of the data collection is included in Table 3.1. Validity relies on "concrete examples of actual practices, fully elaborated so that members of a relevant research community can judge for themselves their 'trustworthiness' and the validity of observations, interpretations" (Lyons & LaBoskey, 2002: 20). Throughout the description of the intervention and explanation of findings I share concrete examples of the pedagogies I researched and data from the intervention is shared in the Appendices.

3.11 Research Design: Action Plan

The research investigated the pedagogical approaches of using playful learning and direct instruction in mathematics. The topics of 2D shapes, time, length, fractions, fractions and decimals and multiplication were taught as part of the research from February to May 2022 in two main research cycles as illustrated in Figure 3.2. As each topic covered was different, different activities were organised and taught for each topic. Within each topic a concurrent mini cycle of preparing, teaching, reflecting, and adapting occurred. The interwoven nature of the cycles and mini cycles is depicted in Figure 3.2.

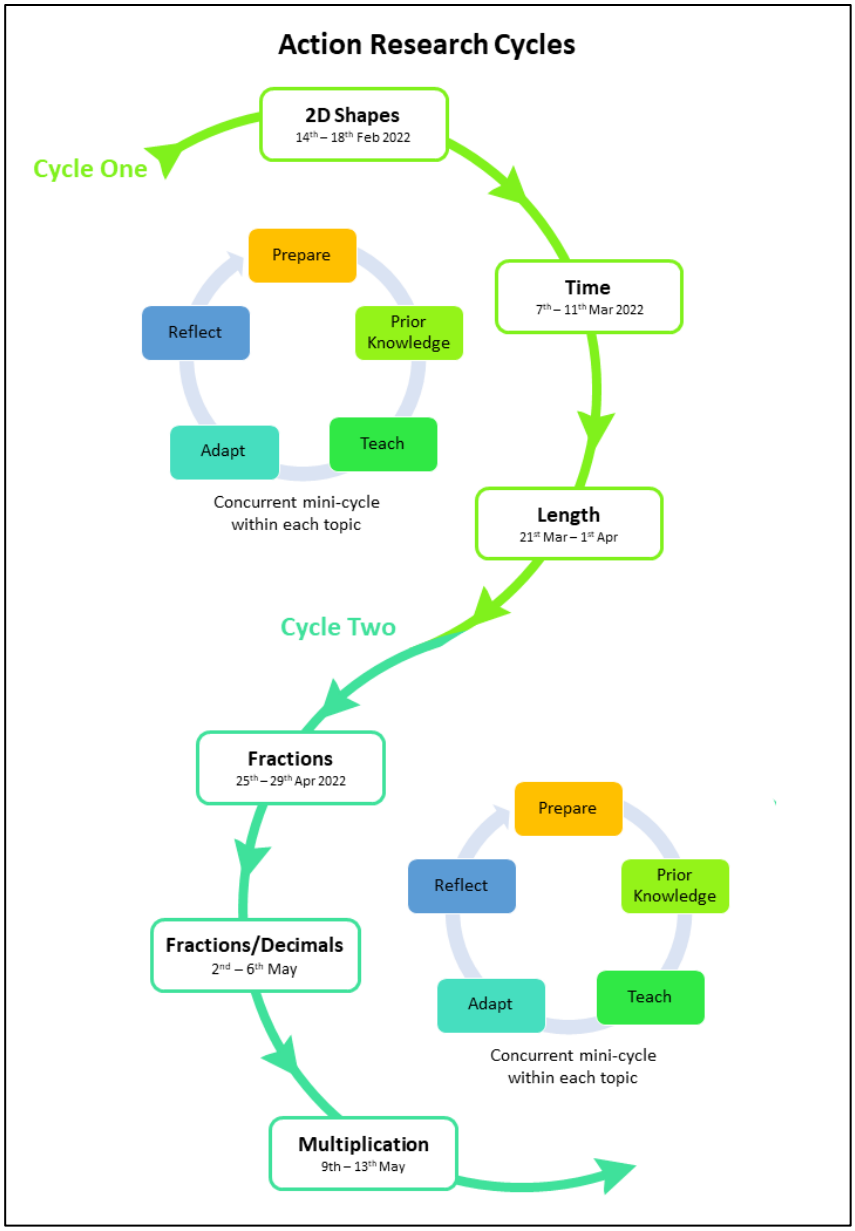


Figure 3.2: Action Research Cycles in my Intervention

Cycle 1 began on 14th February 2022 and Cycle 2 began after the Easter holidays in late April 2022. This was a natural break in the school year and allowed me to reflect on the process up to that point. A final topic had been planned on division but with due to mandatory standardised testing scheduled for mid-May this did not occur.

Guided by the curriculum (NCCA, 1999) I identified learning outcomes for each topic, and used my professional knowledge of the 3rd, 4th and 5th class curricula to identify what the children should know and where I would like to move them to (Willingham, 2009). Once learning outcomes were established, I planned activities for learning. Each week I decided on the specific learning activities that would be used to teach the topic. I identified the areas where direct teaching would be most beneficial to help children gain new knowledge and considered how I might scaffold the learning in achievable steps (Rosenshine, 2012). For each topic being taught I considered how to use both direct instruction and playful learning to optimise children's learning experiences. This involved careful consideration of what learning outcomes the children needed to learn and what activities would be best to help the children learn successfully.

At the start of each topic, I used assessment for learning to identify the children's prior knowledge to establish a starting point. I designed games and activities that would help children to achieve the learning outcomes in each topic. Extension opportunities were outlined for high achievers who needed a greater challenge. New concepts were explicitly taught to the children during direct instruction. The children were actively engaged in playful learning by playing games and working in pairs before consolidating their learning with independent activities. After teaching I reflected on the process and made adaptations where necessary. This process became the mini cycle which occurred within each topic and is illustrated in Figure 3.2.

3.12 Lesson Structure

Initially in Cycle 1 I planned on having a structure where direct instruction, playful learning and time to consolidate learning happened each day. While I did not envision a rigid structure and had planned to use playful learning and direct instruction at different points in the lesson. As the research developed, I found this approach limiting. As I taught the topics, I realised that in some topics the children required greater scaffolding and guidance and some lessons were more teacher-led. Below, in Table 3.2, is the format I originally planned to use in Cycle 1. It demonstrates the rigid mindset of using each methodology in equal amounts each day. This approach was ineffective and limiting.

Time:	Structure 1:	Structure 2:
5 minutes:	Sharing of learning outcomes. Teacher/child led discussion.	Sharing of learning outcomes. Teacher/child led discussion.
15 minutes:	Direct instruction	Playful learning
15 minutes:	Playful learning	Direct instruction
15 minutes:	Independent consolidation of skills.	Independent consolidation of skills.
5/10 minutes:	Correction/ Summary of learning.	Correction/ Summary of learning.

Table 3.2: Cycle 1 Envisioned Lesson Structure

I refined the approach to allow teacher agency in which strategy to use when based on "knowledge of the children and their prior learning; their knowledge of the curriculum; and their knowledge of pedagogy" (NCCA, 2019: 7). In Cycle 2 I adopted a more flexible approach

rather than trying to fit playful learning or direct instruction into a fifteen-minute period each day. I planned to have elements of playful learning and direct instruction over the course of the week when it suited the learning needs of the children in the classroom. As a result, some days had a majority of time spent on direct instruction, while others had a far greater emphasis on playful learning. As mini cycles of change happened throughout each topic, I was also making changes as required throughout to adapt to suit the needs of the class. Further detail of this process is described in the overview of the intervention in the next section.

3.13 An Overview of the Intervention in Action

In this section the intervention is described and discussed. The intervention was designed to address the research question, "how can I enhance my teaching of mathematics by using a balance of direct instruction and playful learning pedagogical approaches?". Kirschner et al. (2006) and Rosenshine (2012) suggest that direct instruction is an effective teaching methodology. Using direct instruction was combined with a playful learning pedagogy which literature suggests is an effective and beneficial pedagogical approach that makes learning joyful, engaging and meaningful (Solis et al.,2021; Zosh et al.,2018; Hirsh-Pasek & Hadani 2020). Using a combination of pedagogies built on the ideas of the NMAP (2008) and Schoenfeld (2004) who suggested that using a combination of teacher-led and child-centred approaches could be an effective method to teach mathematics. Over the course of the intervention six topics were taught as displayed in table 3.3.

Cycle:	Topic:	Date:
Cycle 1	2D Shapes	14th – 18th February 2022
	Time	7th – 11th March 2022
	Length	21st March – 1st April 2022
Reflection Period		2nd April – 24th April
Cycle 2	Fractions	25th – 29th April
	Fractions and Decimals	2nd – 6th May
	Multiplication	9th – 13th May

Table 3.3: Schedule of topics taught in each cycle.

In this section some of the topics taught in the classroom are outlined to illustrate the intervention in action in the classroom. As the intervention took place over several months it is beyond the scope of this dissertation to describe each of the topics in detail. As a result, topics from both cycles are discussed in the upcoming sections: 2D shapes, time and fractions.

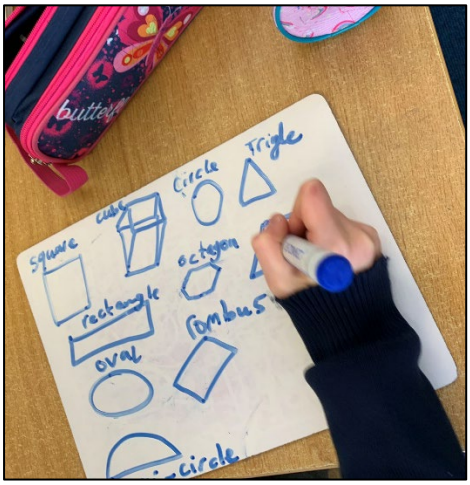
3.13.1 Cycle One: 2D shapes: The Intervention in Action

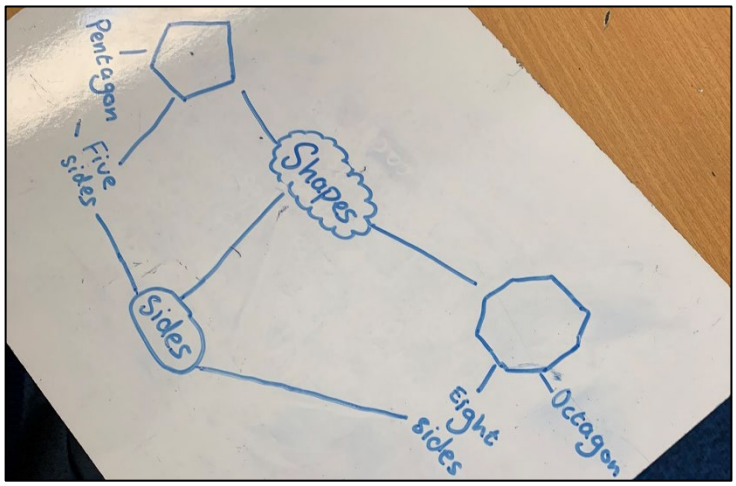
The first topic in Cycle 1 took place from February 14th to 18th and focused on investigating 2D Shapes from the strand Shape and Space. This was integrated with elements from lines and angles and 3D shapes and was the first time the topic had been covered.

3.13.1.1 Eliciting Prior Knowledge and Initial Activities

A pre-topic brainstorm was used to elicit the children's prior knowledge (see Photograph 1 and 2). The children were asked to draw or write about any 2D shapes they knew on their mini whiteboards. This provided a base upon which to extend learning. They then had an opportunity to share these with their peers before a whole class discussion on the shapes we

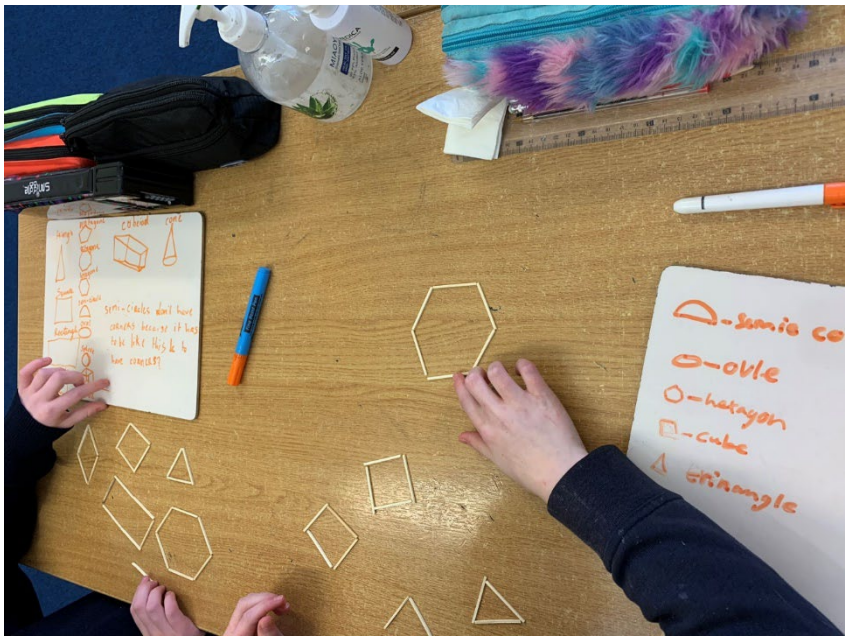
knew. It was evident that many children knew some shapes, however many children drew 3D shapes as well as 2D shapes. The children were not familiar with the different types of triangles. Some children did not know shapes such as rhombus, parallelogram, pentagon, hexagon, heptagon etc.





Photograph 1 & 2: Pre-topic brainstorms to elicit prior knowledge.

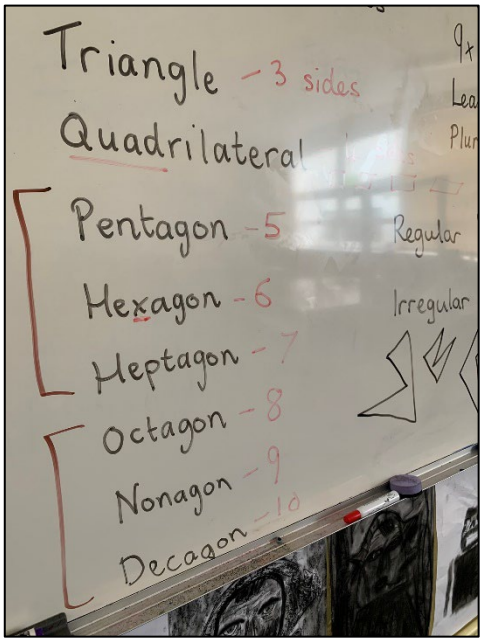
Following the initial brainstorm, the children had an opportunity to engage in free play. They used matchsticks to create the shapes they knew and had an opportunity to discuss their shapes with other children at their desk. This confirmed that the children were familiar with a limited number of shapes. Some children created hexagons and pentagons but could not name them. I noted that the free play activity did not extend learning but was useful to notice misconceptions and areas where the children were lacking in knowledge. Zosh et. al. (2018) suggest that free play has been found to be less effective in academic settings than direct instruction. However, through understanding the misconceptions the children held I could plan learning activities over the course of the week which would help them to develop and change their schemata (Piaget, 1962) to ensure they had the correct knowledge and understanding in relation to shapes.



Photograph 3: Playful Learning in Action – children creating shapes using matchsticks

3.13.1.2 Interactive Direct Instruction Supporting Learning.

Interactive direct instruction was used to share knowledge with the children. Initially, we discussed the shapes the children already knew that they had identified in their brainstorms. As the names of the shapes are not something children could come up with themselves, I explicitly taught the names of the shapes and we discussed what irregular and regular shapes looked like. Children were actively involved in answering questions and thinking of ways to remember names of shapes. For example, a child suggested that there is an x in six and an x in hexagon the six-sided shape to remember that a hexagon is a six-sided shape.



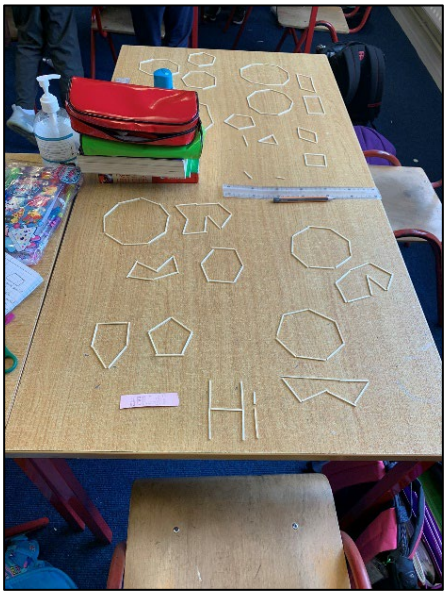
Photograph 4: Direct Instruction during the topic 2D shapes.

3.13.1.3 Playful Learning to develop knowledge about 2D shapes

Following this period of direct instruction, the class engaged in playful learning which is depicted in Photograph 5 below. Their task was to create the outline of different 2D shapes using matchsticks. Guidance was given to ensure that children constructed a wide range of shapes. First children were asked to make two quadrilaterals and then both regular and irregular shapes. Children had freedom to explore. This activity provided a lot of opportunities for discussion as the children worked together to make shapes and identify what shapes they have created. This exploration led to the discovery of 'new' shapes. Children were excited to learn about hendecagons and dodecagons as they created them.

Photograph 5: Playful learning: Creating regular and irregular polygons

There was a buzz of engagement and excitement in the classroom. As the children created shapes, I moved around the room asked them to name and describe the shapes they had created. This provided an opportunity for children to discuss and identify the properties of the shapes. I differentiated my questioning to support and extend children's learning. Evidence of learning was easy to observe. As seen in Photograph 6, one child created one of each type of quadrilateral we had discussed as well as regular polygons, while another child created a regular and irregular representation of each shape beside each other. As an extension, each group then walked around the room to see the shapes other groups had created. The class loved the opportunity to move around the room and to show their friends what shapes they had made.

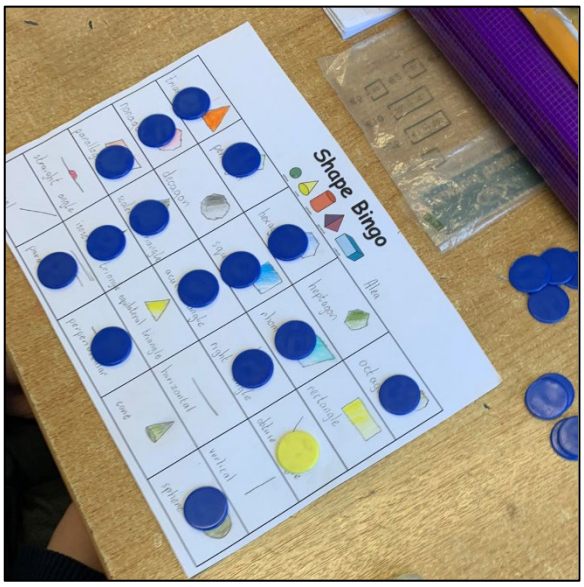


Photograph 6: Evidence of children's learning.

Photograph 7: Creating Shape Bingo Cards.

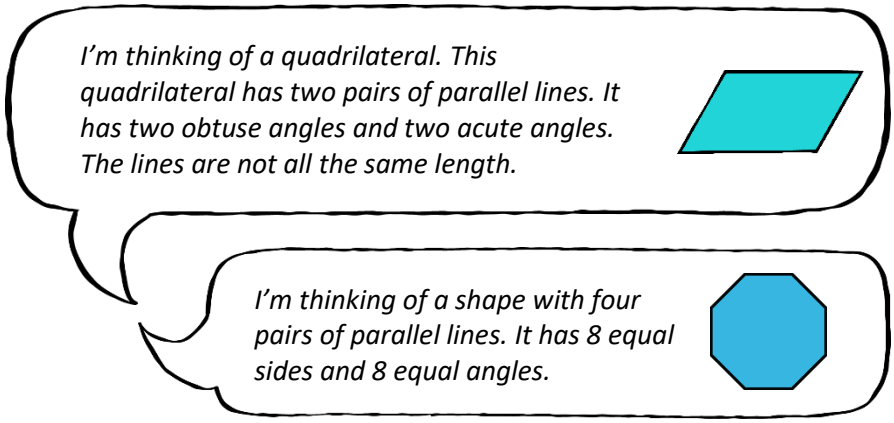
Shape Bingo was another playful learning activity that was used to extend and consolidate learning. The children created their own bingo cards (see Photograph 7) which gave them ownership and choice in the activity. This activity was also adapted and used in the topics of length and decimals and fractions in later research topics.

Shape Bingo as shown in Photograph 8 required active listening and knowledge of the properties of shapes, lines and angles. I called out a series of clues and the children put up their hands to name the shape (See Photograph 9 below). As the clues were detailed and based on the properties of the shapes the children had to listen carefully and apply their knowledge to identify the shapes.



Photograph 8: Playing Shape Bingo.

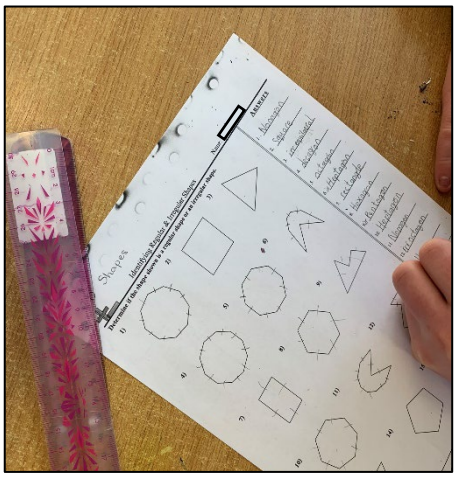
Teacher knowledge of the properties of the shapes was key in this activity. It also provided an opportunity for assessment as I could see which children were confident in naming all the shapes and those who were uncertain. This game was extremely popular with the class and was very effective. It provided an opportunity to revise all the concepts covered and related the different elements of the shape and space strand to each other.

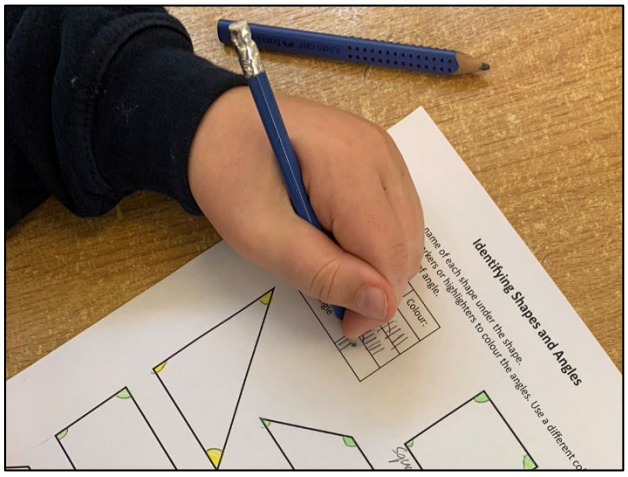


Photograph 9: Sample Teacher Bingo Clues

3.13.1.4 Independent work to consolidate Learning

As well as direct instruction and playful learning activities, the children also completed worksheets which consolidated the learning. Worksheets which specifically targeted the learning that had been completed in class were sourced or created. The textbook had a limited number of questions where children were asked to name shapes. This worksheet in Photograph 10 specifically asked children to name shapes from 3 - 10 sided shapes and had both regular and irregular shapes. This consolidated the learning that had been happening in class.

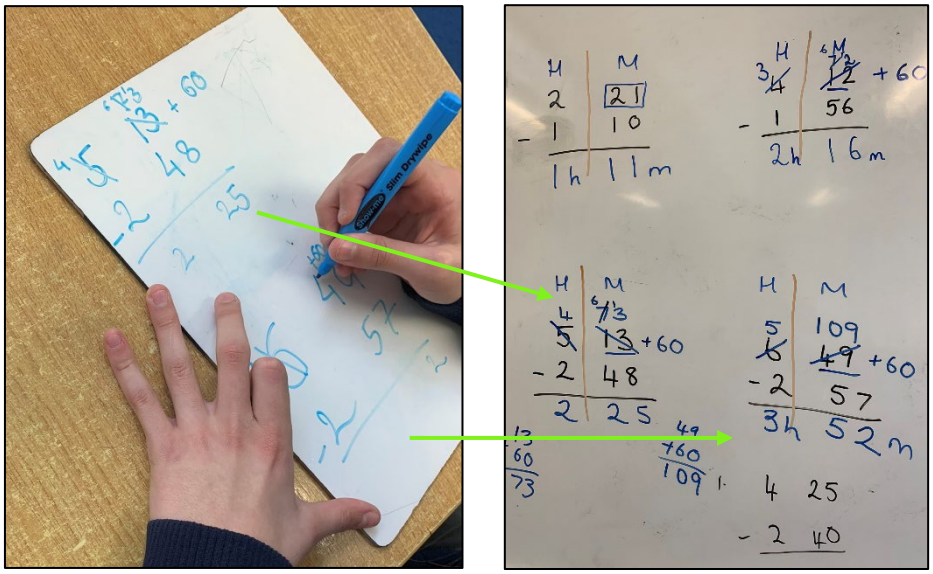




Photograph 10 & 11: Consolidation Worksheets

The topic of time was an example of a topic where teacher flexibility and knowledge of the curriculum was key (Willingham, 2009) as it was a topic where the class attainment was below the anticipated level in 4th class. I first taught the topic of time in November, prior to data gathering. At that point I noticed a majority of the class needed significant support on the topic and that objectives outlined for 4th class in the curriculum (NCCA, 1999) were too advanced for most children. As a result, the pages in the textbook were impossibly complex and the objectives from the 2nd and 3rd class curriculum needed to be explicitly taught as many children could not read the clock in 15-minute intervals.

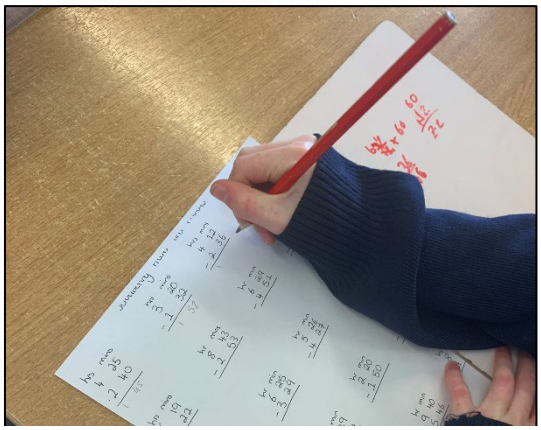
When returning to the topic of time as part of Cycle 1 the aim was to move from reading the clock in five-minute intervals to reading one-minute intervals and to begin to looking at the addition and subtraction of time. Playful learning was used in the form of partner games with the mini clocks. However, explicit direct instruction was necessary to show children how to add and subtract time. On these days mini clocks were used as a quick playful introduction before interactive direct instruction took place. The concept of using a base 60 rather than base 10 was discussed and explored. The children were actively involved in their learning through working on their mini whiteboards and I modelled examples.



Photograph 12: Child working on mini whiteboard after explicit instruction.

Photograph 13: Teacher modelling and guiding practice.

Following the period of interactive direct instruction, the children worked independently on worksheets to consolidate their learning (See Photograph 14). A guided approach where I modelled examples on the whiteboard as the children were working independently was used. I worked at a slow pace and gave time for the children to have a go before modelling the correct solution. This meant that



Photograph 14: Child working independently and using their mini whiteboard as a support.

children who were finding the concept difficult had support as they worked. At the end of the time topic, I noted that we had engaged in “significantly less playful leaning. While we did some warmup activities on reading the clocks using the clock manipulatives the main aim was on the children learning to add and subtract time,” which required additional teacher direct instruction (Hannafin, Reflective Journal, 2022).

I realised I needed to be more flexible in my approach. However, I felt that the interactive direct instruction had been successful as children were successfully adding and subtracting time. A learning support colleague who was in the room toward the end of the week commented on the children’s proficiency and understanding of adding and subtracting time. She felt that this was a concept that sixth class can struggle with and was impressed by the children’s confidence and skill. I felt this validated the choice to use more direct instruction as many children were successfully adding and subtracting time. Despite their success at this time, this topic reiterated the need to have iterative instruction for me. (Rosenshine, 2012; Hattie, 2017) as when I reviewed the children’s learning a few weeks later a number of children struggled with subtracting time. One child noted in the end of intervention that “I think we should go over clock” and another shared “I am not very [good] at time” (End of intervention survey, May 2022). This illustrated good awareness on the part of the children and confirmed my observations that the topic of time needed to be recursively taught as it was a concept that many of the children had found challenging throughout the year.

3.13.3 Preparation for Cycle Two

At the end of Cycle 1 I reflected on the intervention, reflexively evaluated what I had learned and adapted my approach. Rather than trying to use both pedagogical approaches in equal amounts as envisioned in the original lesson structure depicted in Section 3.12, I decided to

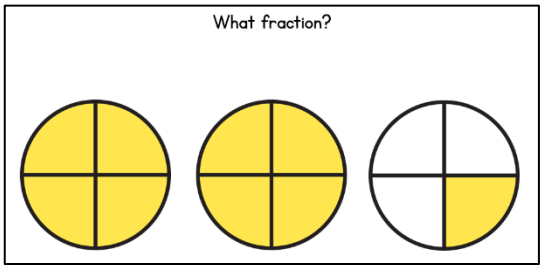
focus on using my personal agency to flexibly choose the pedagogical approach that best suited the learning needs of the class. While I still used both interactive direct instruction and playful learning each week, there was more flexibility in adapting to suit the needs of the class and spending more time on either child led playful learning or teacher-led direct instruction by using my professional judgement to best meet the needs of the class (NCCA, 2020; Hattie, 2017; NMAP; 2008) rather than trying to fit playful learning or direct instruction into a 15-minute block. As I taught each topic I was continually reflecting and adapting my plans to teach what the children needed to know. This process of reflection was part of the mini cycle described in Section 3.11 and meant that great flexibility was needed. At times I used the same game or activity over several days to extend learning. On other occasions the plan for the lesson changed completely when children needed greater clarification on a topic.

3.13.4 Cycle Two: Fractions

This section illustrates some of the key takeaways which came from the topic of fractions and depicts what the topic of fractions looked like during the intervention. This was the first topic of Cycle 2 and took place from 25th – 29th April 2022. Fractions had also been taught earlier in the year and children had learned to identify fractions with different denominators. As I knew what had been previously taught, we did not engage in pre-topic brainstorms to elicit prior knowledge.

3.13.4.1 Direct Instruction during Fractions

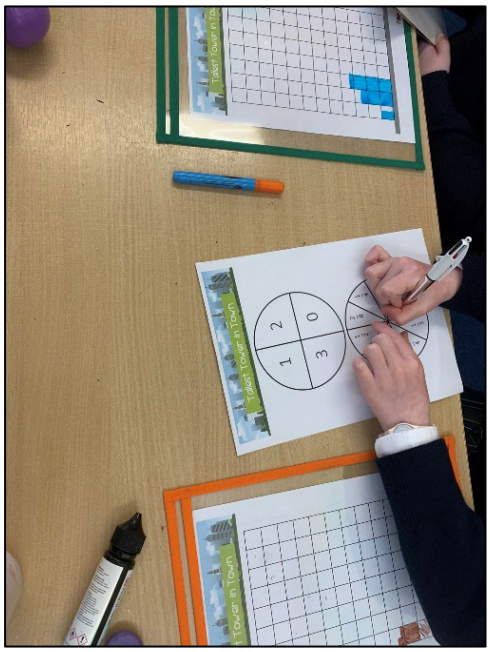
Direct instruction was used to introduce the children to simple mixed numbers. I displayed a number of images on the interactive whiteboard and the children helped to name them. Initially fractions the children were familiar such as $\frac{3}{4}$ or $\frac{5}{8}$ were shown. To extend their learning we moved on to simple mixed numbers such as $2\frac{1}{4}$ as illustrated in Photograph 15. This was interactive as the class were asked to name the fraction shown which led to some interesting discussions. The children suggested several different ways to name the fraction shown including $2\frac{1}{4}$, $1\ 1\frac{1}{4}$ and $\frac{9}{4}$. We discussed each of these solutions and the class agreed that all were correct. This led into explicit teaching of what mixed numbers and improper fractions were.



Photograph 15: Page from the PowerPoint used to initiate conversations about mixed numbers and improper fractions.

3.13.4.2 Playful Learning during the topic Fractions

This section describes some of the playful learning activities used to extend learning during the topic of fractions. I created a game called 'Tallest Tower in Town' to give the children an opportunity to work with mixed numbers and to informally introduce the concept of adding fractions. While many children later identified the game as one they greatly enjoyed, initially a lot of children struggled to play it. To play the game each child spun two spinners, one with whole numbers and

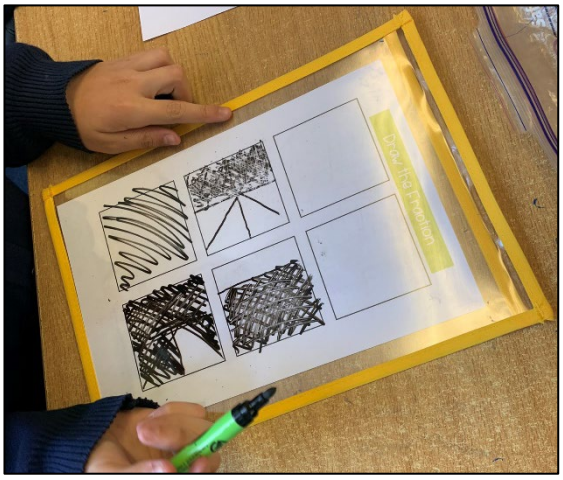


Photograph 16: Playful learning with 'Tallest Tower in Town' game.

one with a fraction. This resulted in a number such as $2\frac{1}{4}$. They then had to colour that number on a grid of squares. The aim of the game was to create the tallest tower possible by colouring squares. Children could only build on top of full squares. For example, if they rolled as $1\frac{3}{4}$ on their next roll they could build upon the $2\frac{1}{4}$ squares already coloured in. I hoped that some children would see the possibility for adding fractions with simple common denominators such as $\frac{1}{2}$ and $\frac{2}{4}$. The game had a lot of potential to illustrate new concepts to the children. Initially, however, there was confusion as the children struggled to colour different mixed numbers. When asked to colour a number such as $2\frac{2}{3}$, a large proportion of the class were not sure how to do this on blank squares.

3.13.4.3 Making Adaptations during a topic:

In order to clarify this concept with the class the following day I gave the children 6 blank squares in the plastic erasable pockets. We practiced colouring in mixed numbers like as $2\frac{3}{8}$ and the children learned to colour two full squares and break the third square into eight pieces before colouring (see Photograph 17). This was an example of needing to evaluate and assess the children's learning during the lesson and to change the intended lesson to suit the needs of the class. When the children had practice of creating different mixed numbers we returned to the game. They then had great success in playing the game.

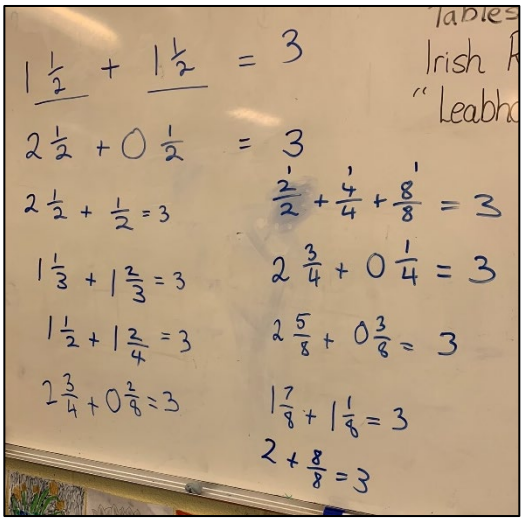


Photograph 17: Adaptations to teach skills needed for game.

Photograph 18: Active Learning in Pairs. Adding fractions to make 3.

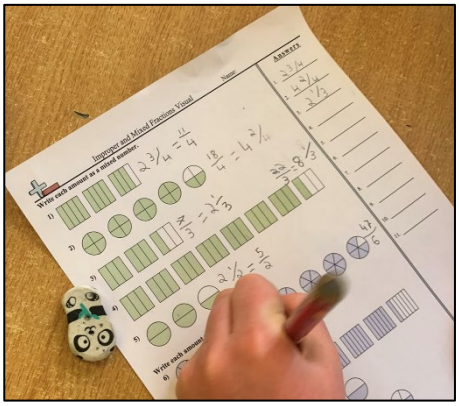
3.13.4.4 Playful Learning as a Method to Extend Learning

The Tallest Tower game also created an opportunity to use the game to further develop the children's learning. I asked the children to think of ways in which they could 'make 3'. We used an initial example of 1 ½ + 1 ½ = 3. They worked in pairs and I was very impressed with the solutions they created some of which are evidenced in Photograph 18. They showed awareness of various concepts of fractions such as adding equivalent fractions and that $\frac{2}{2}$ and $\frac{4}{4}$ equals one as shown in Photograph 19 of the whiteboard. This activity created a foundation to learn about adding mixed fractions, supported by the playful learning in the game.

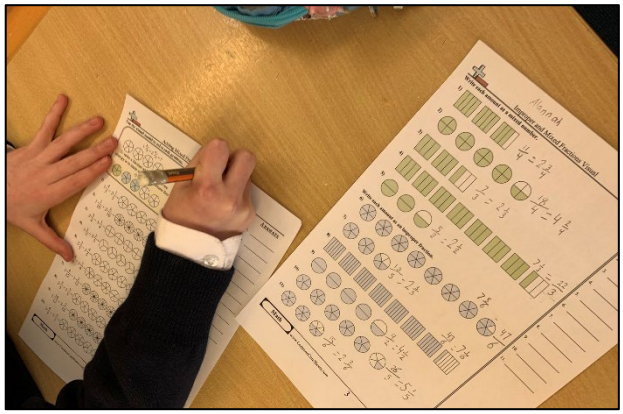


Photograph 19: Record of children's suggestions on the whiteboard.

Adding mixed fractions is a more difficult concept which is not normally taught in 4th class. However, the game provided an opportunity to develop an understanding of mixed numbers and to discover adding fractions. The children were fascinated by the number of ways they could 'make 3'. As evidenced in Photograph 20 and 21 below after a further period of interactive direct instruction based on mixed numbers and improper fractions, worksheets were used to consolidate children's understanding. Early finishers completed a second worksheet which was more challenging as they were required to add mixed numbers of the same denominator and write their answer as a mixed number. Some children were challenged to write their answers as both a mixed number and an improper fraction.



Photograph 20: A child completing worksheets based on their learning about mixed numbers and improper fractions.



Photograph 21: Extension activity for early finishers with visuals for adding mixed numbers.

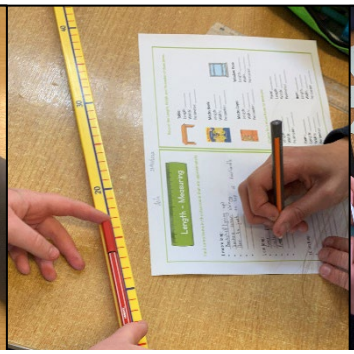
3.13.5 Reflection on the Intervention

The examples shown in the previous sections illustrate the nature of the activities which occurred throughout the intervention. As evidenced in this section many interactive and engaging lessons took place over the period of the study. While it is not possible to describe each moment in the intervention due to the sheer amount of detail that would be required, these examples give an insight into what the intervention looked like in the classroom. A selection of the games, activities and templates which were used throughout the intervention are included in Appendix IX.

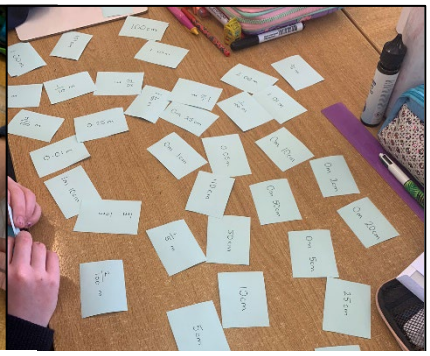
The children's learning was of paramount importance and both direct instruction and playful learning were used within each topic and each cycle. After each lesson I reflected on the children's progress and made plans for the next steps to further their learning. At each stage I considered how I could most effectively use direct instruction and playful learning activities to help children achieve the learning outcomes. My value of providing high quality education spurred me on to evaluate each activity. Where necessary I adapted, re-taught or moved on when children had achieved the objectives. I felt the intervention successfully focused on the pedagogical approaches of direct instruction and playful learning. Critically reflecting on my

practice and using an action research approach allowed me to narrate, navigate and renegotiate my values (Kelchtermans, 2018) and to be flexible in my approach.

Photograph 22: Playing games to learn multiplication facts.



Photograph 23: Playful learning with measuring.



Photograph 24: Playful learning: Card games during length.

3.14 Data Analysis

The data was analysed using a reflexive thematic analysis approach as described by Braun and Clark (2006, 2019). Thematic analysis is suitable for an action research approach as its flexibility allows a range of data sources to be considered. It is a method for identifying, analysing, organising, describing and reporting themes found within a data set (Braun & Clarke, 2006) and is a useful way to establish themes in a study such as this which uses qualitative research methods. The six-step process suggested by Braun and Clarke (2006) includes familiarisation with the data, generating initial codes, searching for themes, reviewing the themes, naming the themes and finally producing a report.

To begin the thematic analysis, I reflected upon my reflective journal and read the surveys completed by the children during the process. I reflexively considered the photographs which were taken throughout the data collection process and analysed my own perspectives. Additionally, I transcribed the data collected from audio recordings of conversations with the

children. After printing these and using highlighters to colour code key phrases I began to bring my knowledge of all these sources together and began to assimilate and synthesise the information. I began to generate codes to describe the patterns that were emerging from the data. I reviewed the codes and found links between them and initial themes formed. I reviewed the data and began to name and define the themes. The themes were evaluated in connection with my research question and my values (Braun & Clarke, 2006). This was a laborious and at times challenging process as there was a lot of data to consider. The 'messiness' of action research, described by Schön (1983: 42) as "swampy lowlands" came to the fore as I attempted to define and name the key themes which were emerging and to ensure validity and accuracy in how I named the themes.

3.15 Conclusion

Using an action research paradigm allowed me to have a central positionality in the research and conduct the research in line with my values. This chapter has provided a rationale for the choice of a self-study action research approach, an outline of the intervention that took place in the classroom, the rationale for the data collection methods, ethical considerations and the use of thematic analysis as a means for analysing the data. In the next chapter the key findings from the research are presented and discussed.

Chapter Four: Findings and Discussion

4.1 Introduction

The key codes that emerged from the data analysis process as described in Section 3.14 are included in Figure 4.1 below. These were later sorted into three themes under the headings 'Role of the Teacher', 'Playful Learning' and 'Flexible Approach' as evidenced in Figure 4.1.

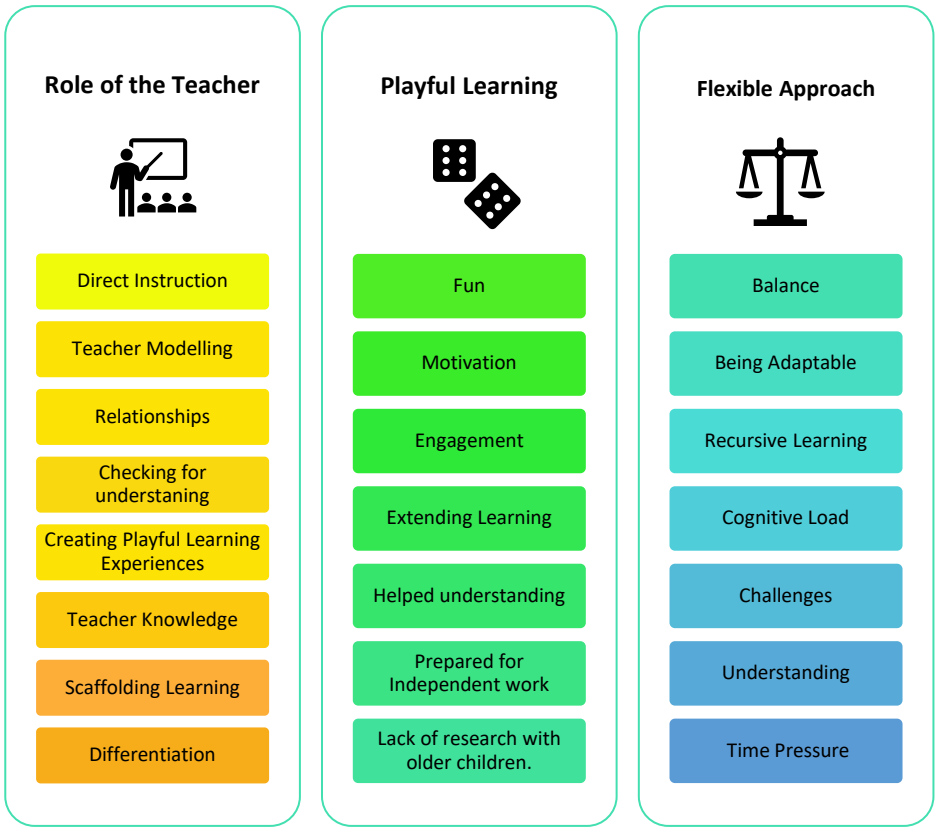


Figure 4.1: Codes emanating from the data analysis process.

A number of key findings emerged under the three themes 'playful learning', 'role of the teacher' and 'flexible approach' which emanated from the data analysis. Figure 4.2 below illustrates the three central themes which emerged from the research and the associated findings relating to each theme.

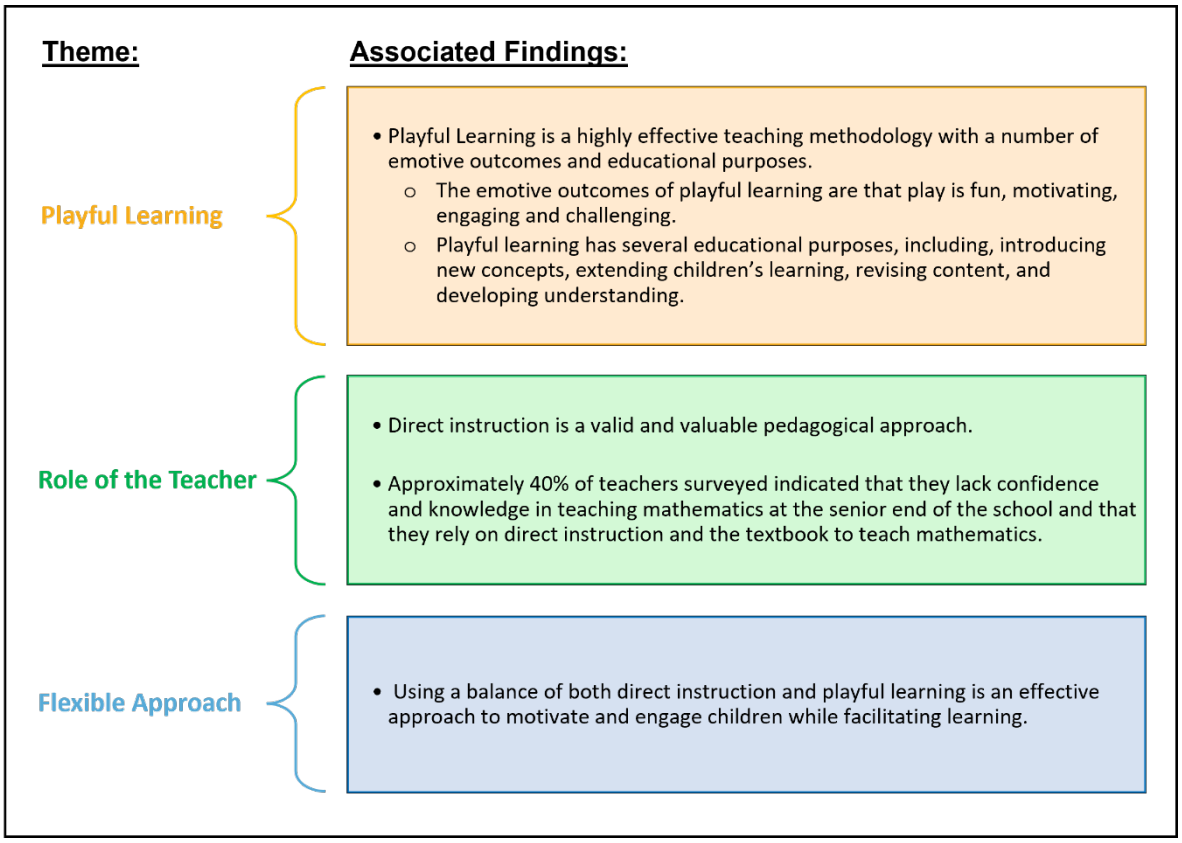


Figure 4.2: Themes and associated findings emerging from the data analysis process.

The first finding relates to the theme of playful learning and purports that playful learning is a highly effective teaching methodology with several significant purposes and outcomes. The second finding relates to the role of the teacher and contends that direct instruction is a valid and valuable pedagogical approach. The third finding interlinks these two pedagogical approaches to suggest that using a balance of both direct instruction and playful learning is an effective approach to motivate and engage children while facilitating learning. The final finding relates to the role of the teacher within the wider Irish educational context. Teachers' surveys indicated that a considerable amount of Irish teachers feel they lack confidence and mathematical knowledge to teach mathematics in the senior classroom and rely on traditional methods such as direct instruction and the textbook.

4.2 Finding One: Playful Learning as an Effective Methodology

My first finding emanated from the theme of playful learning. The data suggests that playful learning is a highly effective teaching methodology with a number of significant educational purposes and emotive outcomes. As delineated in Figure 4.3, these include the educational purposes of extending learning, introducing new concepts, revising content and developing conceptual understanding as well as the emotive outcomes of engaging learners, enjoying a challenge and increasing motivation to learn. This vision of playful learning was developed from my considerations of the data from the children's survey responses, interview transcripts, reflections on the literature and my personal reflections on the intervention.

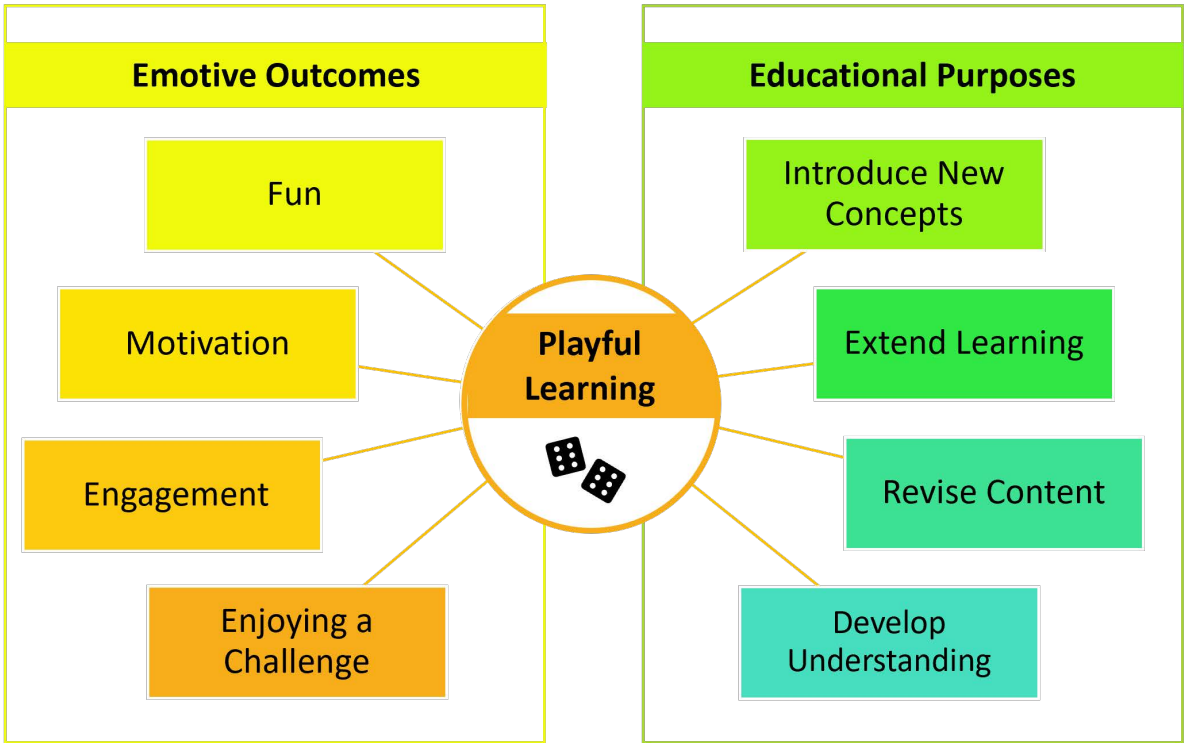


Figure 4.3: My vision of the emotive outcomes and educational purposes of playful learning as evidenced in my research.

These educational purposes and emotive outcomes are interlinked and impact on children's experiences of learning in mathematics. In Section 4.2.1 the emotive outcomes of playful

learning and their impact on the children's learning and attitude towards mathematics is discussed. In Section 4.2.2 the related educational purposes of playful learning and their impact on the children's learning are outlined in relation to the data gathered throughout the intervention.

4.2.1 Emotive Outcomes of Playful Learning

As previously described in Section 4.2 this research suggests that play can be described as having several key purposes and outcomes. Playful learning was a pivotal methodology in my classroom this year and it had key emotive outcomes. The key emotive codes that emerged from the thematic data analysis process (Braun & Clark, 2006) under the theme of playful learning were that playful learning is fun, motivating, engaging and challenging. This contention is supported by literature which suggests that play makes learning enjoyable, engaging, rewarding, iterative and cognitively challenging (Hirsh-Pasek & Hadani, 2020; Zosh et al., 2018). 'Fun' was the word that children frequently used to describe playful learning and it was mentioned repeatedly throughout the research in interviews, written surveys and said aloud in the classroom. A sample of responses from Written Survey 1 which indicates the value children placed on having fun is depicted in Figure 4.4.

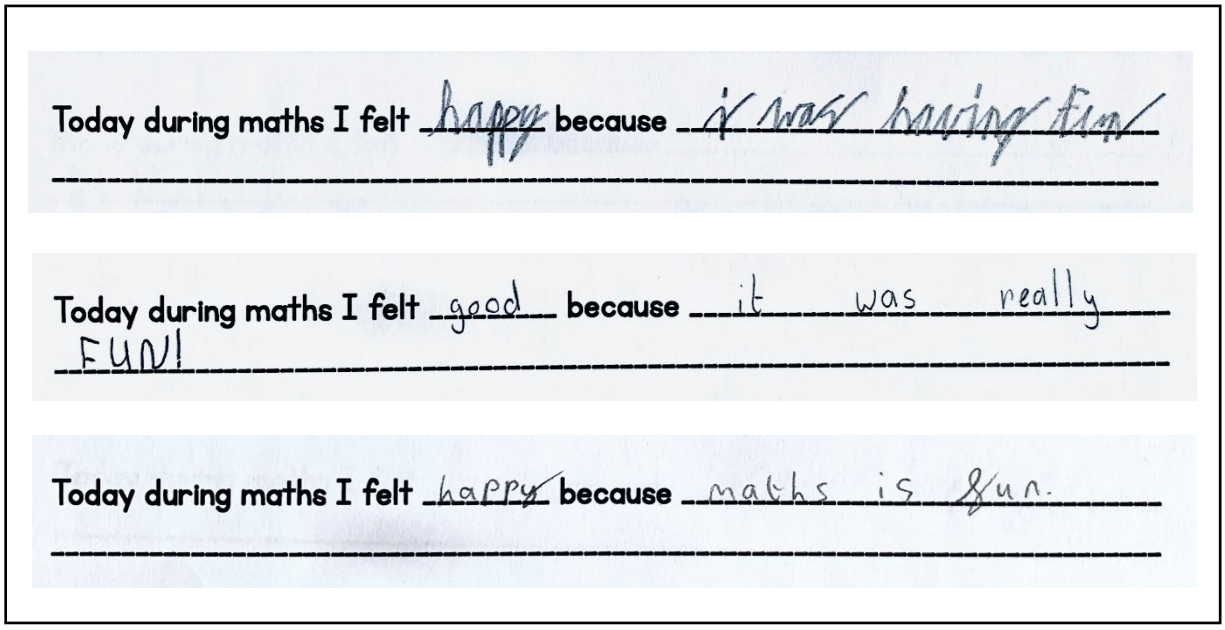


Figure 4.4: A selection of children's responses to Written Survey 1 highlighting their value of having fun

When asked what they enjoyed in mathematics in both written surveys and group interviews, the children frequently first mentioned games and playful learning activities. In a written survey carried out on the 1st of April all seventeen children (n = 17) who completed the survey felt the games and activities helped them learn. Furthermore, the children identified the activities they enjoyed. One child wrote "I liked measuring things around the room and mathematics bingo because they were interesting and fun" (Child, Written Survey 1). Another child wrote "I liked mathematics bingo because it's fun, helps you learn and competitive" (Child, Written Survey 1).

In the small group interviews, there was consistent feedback that children enjoyed the playful learning activities (See interviews 1 – 9 in Appendix V). As Child 10 noted "learning mathematics through games is awesome" (Child 10, Interview 1). When engaged in playful learning children were highly motivated and interested in taking part. There was significant evidence throughout the research which illustrates that children found playful learning activities motivating and engaging, a concept which is backed by substantial literature (Hirsh-

Pasek & Hadani, 2020; Zosh et al., 2018; Solis et al., 2021) and I I observed this on numerous occasions including the extract from my reflective journal below:

> "There was a buzz of excitement in the air throughout the game. There was laughter and joy when the children got to cover a shape. Every time I shared a clue, hands shot into the air… when an answer was called out there were calls of 'yes' and 'no' when children didn't have the answer on their bingo boards. Every member of the class was engaged and enthusiastically waiting for the next clue. I loved the intense concentration when I shared a more challenging clue as children tried to figure it out… When the game ended child 7 asked 'Please can we play again? Just one more round?'"
>
> (Hannafin, Reflective Journal, 16/02/22)

In this observation I noted the buzz of excitement in the room and words like 'engaged' 'enthusiastically' and 'concentration' convey the positive mood in the classroom. While this observation took place in February, bingo was a game that I used in different ways throughout several topics of the intervention including the topics of 2D Shape, Length and Fractions and Decimals. The children's enthusiasm for Mathematics Bingo was also evident in Written Survey 1 which was conducted in April. A vast majority of the class mentioned bingo as an activity they had enjoyed during the week as evidenced from their responses below.

> 'I loved the bingo because it was fun and helpful'
>
> 'Maths bingo it helped me to learn more things about length'
>
> 'I liked doing bingo because it was fun'
>
> (Children's Responses, Written Survey 1)

UNICEF (2018) states that "play-based learning approaches can transform the educational experiences of children in the early primary grades and strengthen learning motivation and

outcomes". This motivation was apparent in my 4th class classroom. I found that student engagement was positively affected by games. Children often asked to play games again. On another occasion a child commented "Awww P.E. … Do we have to do P.E? I'd prefer to do mathematics!" (Child 15, as quoted in Reflective Journal, 22/03/22) This was the perspective of one child but it was notable because it surprised me. The child in question usually loves P.E. and takes part in several athletic activities outside of school. This conversation happened as we were walking in from the yard and we had P.E. scheduled at our usual mathematics time. While most children would always choose P.E. over mathematics, I felt that this simple statement shared with bright eyes and enthusiasm stood out for me. That week this child was enjoying mathematics so much that she didn't want to miss it. This was a moment which showcased the motivation, joy and excitement children were experiencing during mathematics.

In the end of intervention survey carried out on May 20th, 2022, the children identified the feelings they felt while playing games during mathematics as demonstrated in Figure 4.5.

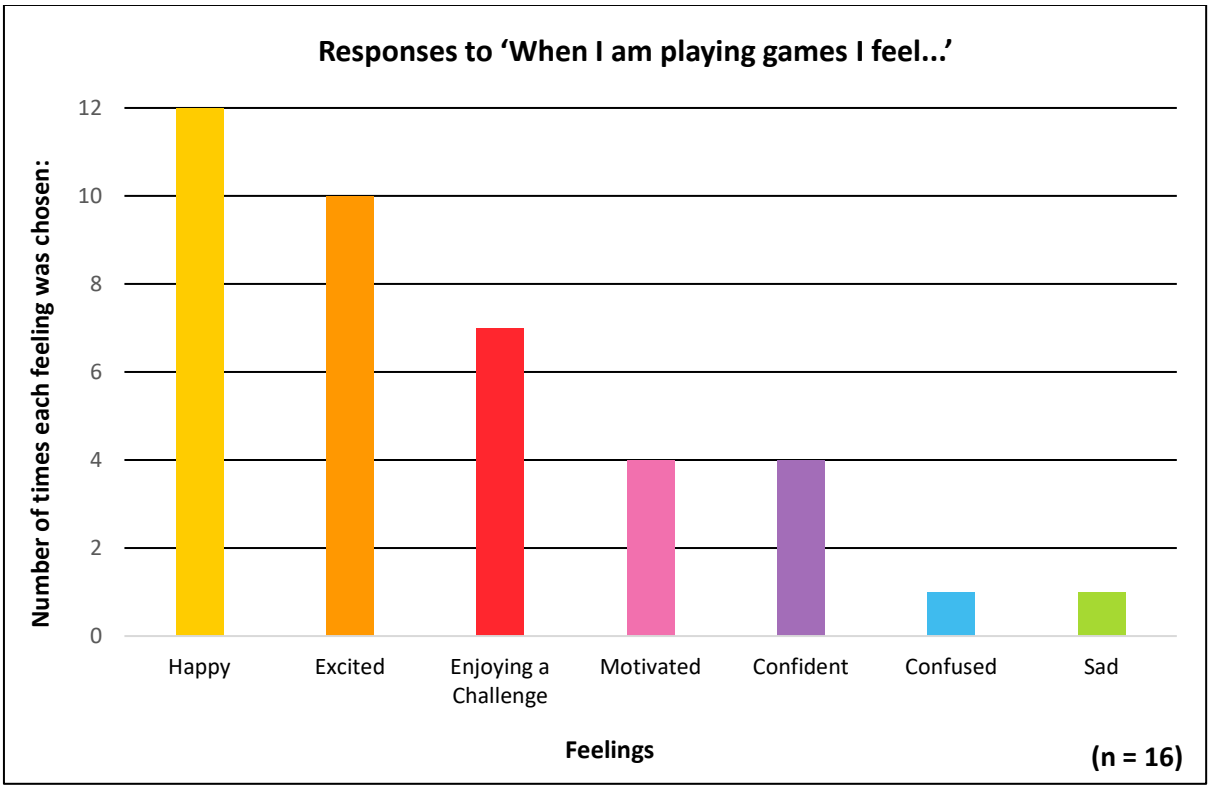


Figure 4.5: End of Intervention Survey Question 'When I am playing games I feel…'

Children identified a range of emotions they felt while playing games during mathematics class. As children could choose more than one answer a majority chose a combination of emotions. For example, 10 of the children who answered (n = 16) chose both happy and excited as options among their choices. This is significant as it shows the 'joy' children experienced while engaged in playful learning (Hirsh-Pasek & Hadani, 2020). As evidenced in the above table the emotions are primarily positive but two negative emotions were chosen, 'confused' and 'sad'. Interestingly, the two children who chose those emotions both felt that games help them learn and that games were 'fun'. I feel it is important to also note that games can evoke many different emotions and help children to improve their emotional regulation (Singer et al., 2006). As mentioned in Section 2.4.7 the joyous nature of play can reduce the anxiety children can feel in relation to mathematics and help them cope with adversity (UNICEF: 2018).

As described in this section the children looked forward to and appreciated the playful aspects of mathematics lessons. This was frequently evident as children asked about the games we would be playing and if we could play again. When a game was more challenging children were interested to improve their skills to be able to play.

4.2.2 Educational Purposes of Playful Learning

As well as emotive outcomes playful learning discussed in Section 4.2.1 has several educational opportunities and benefits. As evidenced previously in Figure 4.2, the data suggested that playful learning had several educational purposes, including, introducing new concepts, extending children's learning, revising content, and developing understanding. Play has long been recognised as a central way children learn as previously outlined in Section 2.4 (Froebel, 1887; Dewey, 1938; Piaget 1977; Vygotsky, 1978; Brown, 2010; Hirsh-Pasek &

Folinkoff, 2008; Solis et al., 2021). In line with my value of providing high quality education the aim of the playful learning activities was to enhance the children's learning experiences and to help them achieve the relevant learning outcomes. The overall aim of every game was to have an impact on the children's learning. The data from the interviews suggested that children felt games enhanced their learning. This is supported in the literature by Mardell et al., (2021) who suggest that during play children can engage in deep learning, consolidate skills and retain what they have learned.

4.2.2.1 Use of Playful Learning to Extend Learning

In Written Survey 1 carried out on the 1st of April, all seventeen children (n = 17) who completed the survey felt the games and activities helped them learn. Interestingly, in Written Survey 2 two children (n=16) felt the games that week did not help them learn. In that week the playful learning activities were based on fractions and were designed to extend learning, so the games proved more of a challenge. For some children the challenging nature of the games may be why they did not feel they helped them learn. Initially, the Tallest Tower game proved a challenge for a number of children. This was evident from statements in Interview 2 such as "The tower at first. [was difficult]" (Child 4, Interview 2) "That was kind of hard. I didn't know what to do" (Child 2, Interview 2).

However, many children (see Interview 1,2,3 and 4 in Appendix V) also indicated that once they understood the game, they really enjoyed it and they felt that it had a positive impact on their learning. One child demonstrated their awareness of their learning in Written Survey 1 as illustrated in Figure 4.6. Overall, the feedback on the challenging games was positive, evidenced from the example such as Figure 4.6 and several children's comments about their learning and enjoyment as a result of the game in Interview 1,2,3 and 4. This contention that

children can learn as a result of experiencing challenges is supported by Mardell et al. (2021), who suggest that in play, children's attention is focused and they strive to succeed and embrace challenges. I found that playful learning activities positively affected children's attitude to challenging tasks in mathematics.

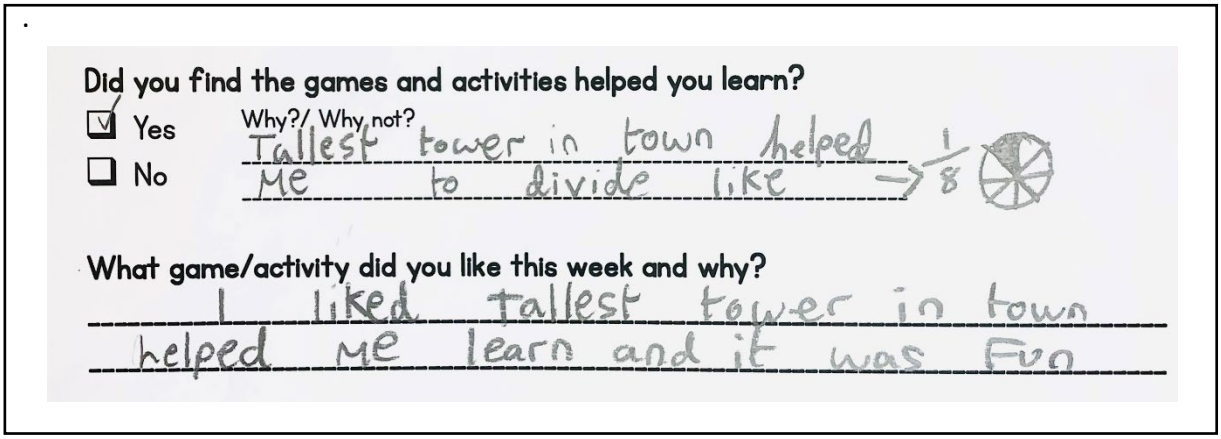


Figure 4.6: A Child's response to Written Survey 2 which demonstrated their learning and opinions about the Tallest Tower game.

Another simple activity which extended children's learning was identifying items around the room that were approximately one metre in length. In my observations I noted that most of the class struggled to visualise the different lengths. By exploring the classroom and finding items of different lengths the children showed a far greater comprehension.

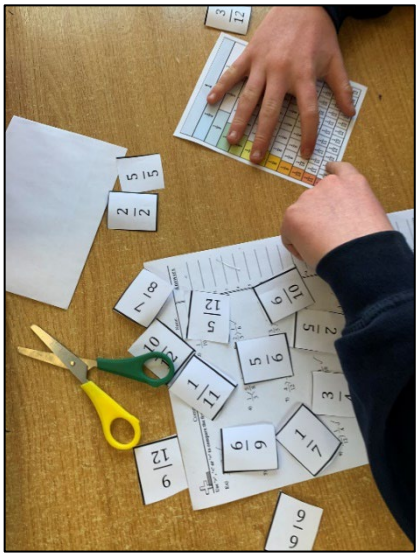
> "I was very surprised at how challenging the children found identifying items of different lengths around the classroom. Many of the kids had no idea how long a metre was, they couldn't visualise it. The activity to use metre sticks and rulers to find items of different lengths around the room was very beneficial. It really gave the children a sense of what a metre looked like…. a spontaneous moment of playful learning happened during the class as one child shared that a great white shark is 4m long. We measured it out across the room and the children were fascinated."
>
> (Hannafin, Reflective Journal, 21/03/22)

This extract shows that even the simplest of activities can help children to develop an interest in topic and extend learning. Embracing a child's interest in sharks in a playful way also made the learning meaningful for the children (Mardell et al., 2021). As well as being enjoyable,

playful learning supported children's motivation to learn and helped them connect new knowledge to their prior knowledge a concept which is supported by Solis et al. (2021).

When playing equivalent fraction snap and the fraction blaster board game (See Photograph 25 and 26 below) some children's learning was extended through use of more complex fractions and decimals, while others used the basic cards to reinforce their learning. The children had the opportunity to create their own game cards to play with. As the games were designed to help children achieve the learning outcomes, they often helped children develop their understanding as is evidenced in many of the games already described Section 3.13. In Photograph 26 children can be seen using their fraction wall to compare the size of two fractions. Over the days playing the game I observed that the children gained a deeper understanding about the size of fractions and relied less on the fraction wall as noted in my reflective journal.

Photograph 25: Fraction Blaster Game, Converting decimals to fractions.



Photograph 26: Comparing Fractions Game

Each topic had numerous different playful learning activities as evidenced from the examples in this section. Each of the games and activities were designed to enhance learning. I

observed the children displaying more confidence in their ability as a result of the games and the children themselves also felt that playful learning positively impacted their learning. In the end of intervention survey 100% of children (n = 16) said that games helped them learn, a contention which was also echoed in several Interviews when the children referenced the games as something that helped them to learn in mathematics.

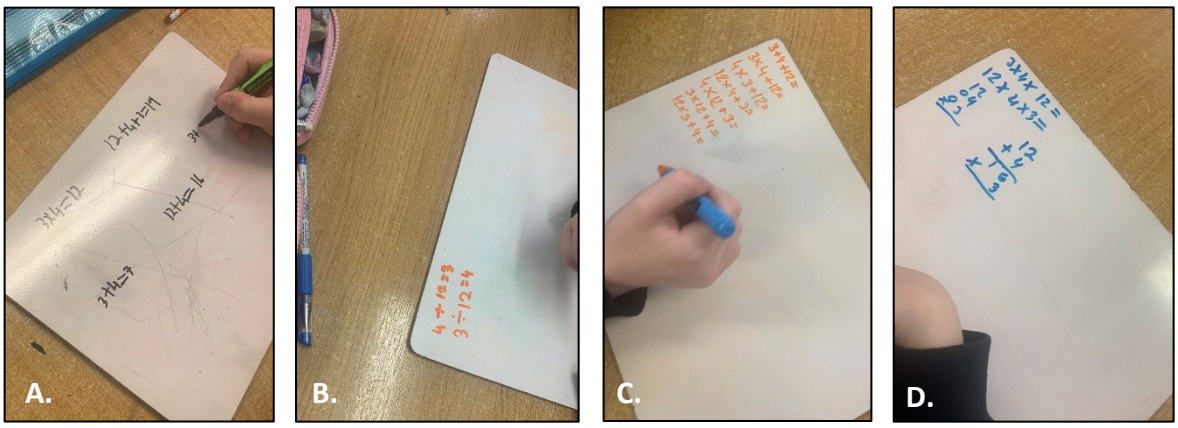
4.2.2.2 The Role of Free and Minimally Guided Play

I found free and minimally guided playful activities to be less beneficial in terms of extending learning in mathematics. This correlates with past research which found that free play was less effective in academic settings than direct instruction (Pianta et al., 2009; Fuller et al., 2017). Notably, it did provide opportunities for dialogue and illustrated misconceptions that the children had which was very useful for me as it afforded an opportunity to adapt the learning outcomes to address these misconceptions.

This was evident during the topic of shapes when children greatly enjoyed an opportunity to create different shapes as previously described Section 3.13.1. At the end of the free play I couldn't discern new learning as the shapes the children created reflected the prior knowledge they demonstrated in the pre-topic brainstorm and there was no evidence to suggest that children had learned anything new, as noted in my observations and in the photographs taken of the free play. However, I did notice that some children were unaware of the difference between 2D and 3D shapes which allowed me to address this misconception in a later lesson.

On another occasion, during the topic of multiplication, I asked the children to use the digits 3, 4 and 12 to make some mathematical equations. I was expecting that some children would demonstrate the commutative property of multiplication. I did not give more instruction as I

was hoping that the children would use their own initiative to come up with different sums. However, most children returned to addition and or created sums with all three numbers as evidenced in Photograph 27A, 27C and 27D. The children who created equations with multiple symbols were unsure how to solve them. A very small number of the class used division in their equations. Of those, a number showed misconceptions such as the example in Photograph 27B where the child in question wrote 4 ÷ 12 = 3 and 3 ÷ 12 = 4. It was evident that the children were not comfortable using division and the commutative property of multiplication was not developed despite being covered earlier in the year. As a result, the lesson was adapted to spend time discovering this. We examined several division sums and looked at what they had in common. Additionally, we spent time investigating the commutative property of multiplication. Again, this highlighted the need for recursive or iterative learning of concepts (Hattie, 2009; Rosenshine, 2012; Willingham, 2009; Liu et al., 2017).



Photograph 27: Children's responses to task on mini whiteboards.

It is therefore important to consider the purpose of free or minimally guided play. In the senior classroom I envisioned play as a methodology to enhance learning. In Aistear (NCCA, 2009) free play and the children learning through their own imaginative play is

recommended. In my classroom, free play did not extend children's learning in the same way that teacher-led playful learning and direct instruction did. Notwithstanding, while free play may not be as effective as a leaning methodology it can have other benefits such as the development of socio-emotional skills (Zosh et. al, 2018) and in identifying misconceptions. I found that was a time when children communicated well with each other and it afforded me an opportunity to observe children's knowledge and discern potential misconceptions. In keeping with a constructivist approach, misconceptions were viewed as opportunities for learning which was noted by Child 8 (Interview 7) in the phrase "Well like… you learn from your mistakes".

4.2.2.3 Conclusion to Finding One: Playful Learning

The data suggests that playful learning is an effective teaching methodology with several key educational purposes and emotive outcomes, including, introducing new concepts, extending children's learning, revising content, and developing understanding. As a result of considering the collected throughout the intervention in terms of the surveys, interviews, personal reflections and my analysis of literature I suggest that playful learning is an effective teaching strategy.

Play is fun for children, and is engaging and motivating for them, a concept backed by the data from my interviews and written surveys as well as several sources in literature (Zosh et al, 2017; Mardell et al., 2021; UNICEF, 2018). Furthermore, playful learning enables children to extend their learning as evidenced in my context in Section 4.2.2.2, and this idea is also purported by Zosh et al. (2018: 3) who suggest that guided play, with its adult support and focus on supporting children to achieve learning outcomes can "offer an optimal pedagogical approach in academic contexts".

4.3 Finding Two: Direct Instruction

The second finding emerged from the theme 'The Role of the Teacher' which was a central tenet of my research and contends that interactive direct instruction is a valid and valuable pedagogical approach for teaching mathematics. The role of the teacher while essential in mathematics education (Rosenshine, 2012) is multifaceted and complex and this contention, noted earlier in the literature review (see Section 2.3.1), was reinforced during my research intervention. My conceptualisation of the multifaceted role of the teacher in mathematics education is depicted in Figure 4.7.

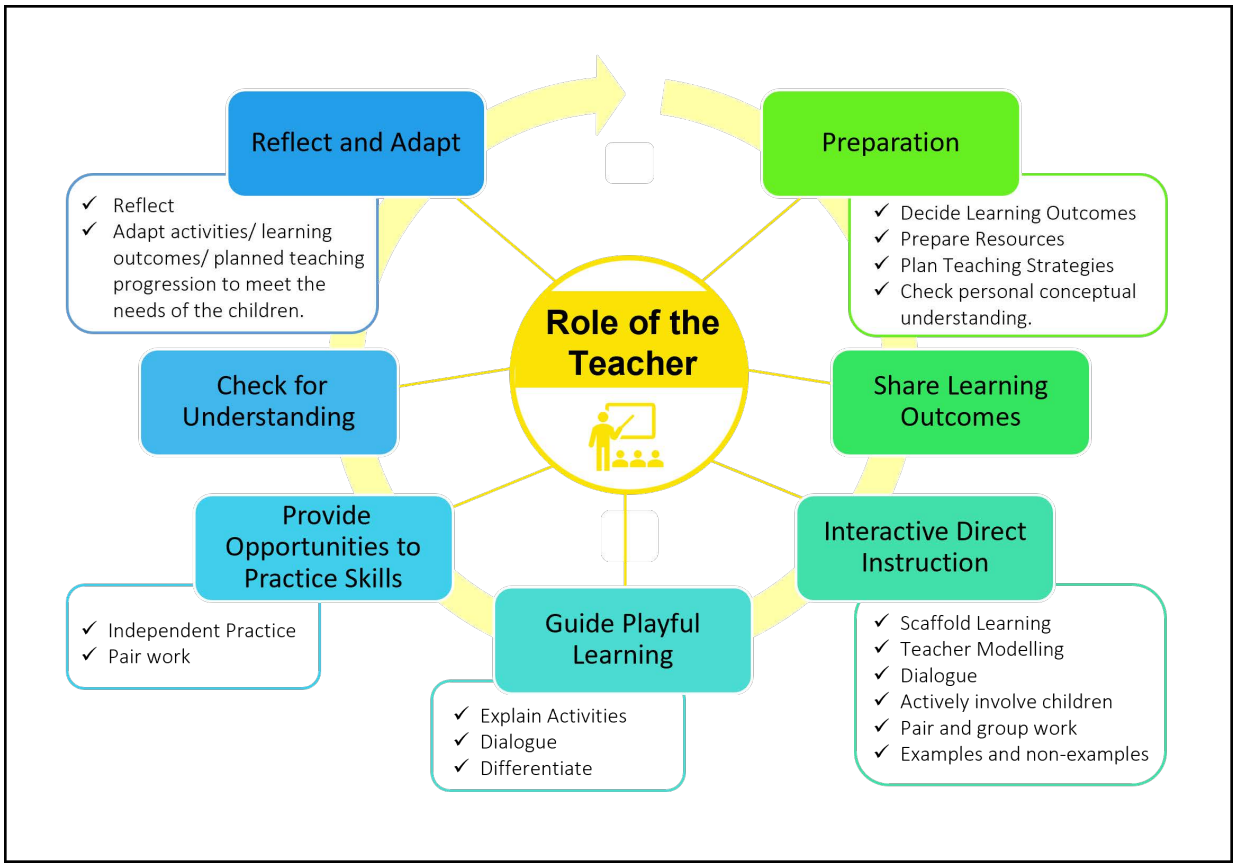


Figure 4.7: My Vision of the Role of the Teacher in Mathematics Education.

Based on the roles I needed to undertake during the intervention, it involves several key elements, including, preparation for learning, sharing learning outcomes, interactive direct

instruction, guiding playful learning, providing opportunities for children to practice the skills they were learning, checking for understanding and reflecting and adapting the learning progression to suit the needs of the class. These key elements interlink and support each other, and the teacher may engage in many of these elements over the course of a lesson. It is important to note that while interactive direct instruction is a key element of the role of the teacher, this pedagogical approach is supported by the other roles noted in Figure 4.7. As an in-depth analysis of the multifaceted nature of the role of the teacher is beyond the scope of this research, the focus for the remainder of this section is on interactive direct instruction as a valid and valuable pedagogical approach for teaching mathematics.

4.3.1 Interactive Direct Instruction Pedagogy

Interactive direct instruction is a key tenet of the intervention undertaken in my classroom. To differentiate the direct instruction used in my classroom from a purely instructionist conceptualisation of direct instruction I refer to it as interactive direct instruction. This vision of direct instruction which is interactive and child-centred was previously defined in section 2.3.3 by Hattie et al. (2017).

During interactive direct instruction I scaffolded the learning for the children. Examples were shared on the board and children were given an opportunity to work independently or in pairs to solve the questions. Different strategies were used such as giving examples and non-examples for children to identify. (Hattie et al., 2017) Children participated actively and had opportunities to engage in discussions and demonstrate their learning on mini whiteboards. A key part of interactive direct instruction is the role of the teacher in modelling and scaffolding the learning. (Hattie et al. 2017; Fisher & Frey, 2013). The aim of this was to share information and help children learn new concepts by giving examples and collaboratively

working through examples (Rosenshine, 2012; Hattie et al., 2017). The children valued the teacher's clarity and explanations. This was evident throughout the intervention in their responses. For example, in Written Survey 1 a child responded to one question with "Today during mathematics I felt great because it was fun and I understood everything very clearly" (Child, Written Survey 1). When asked in Written Survey 2 if the teacher's explanations during interactive direct instruction helped them learn 15 of the 16 children who completed the survey responded positively with comments such as: "Yes because it helped me understand", "She showed us on the board" and "It helped me understand all the fractions and about mixed fraction". (Children, Written Survey 2). The children valued being able to understand and know what to do as is evidenced in Figure 4.8.

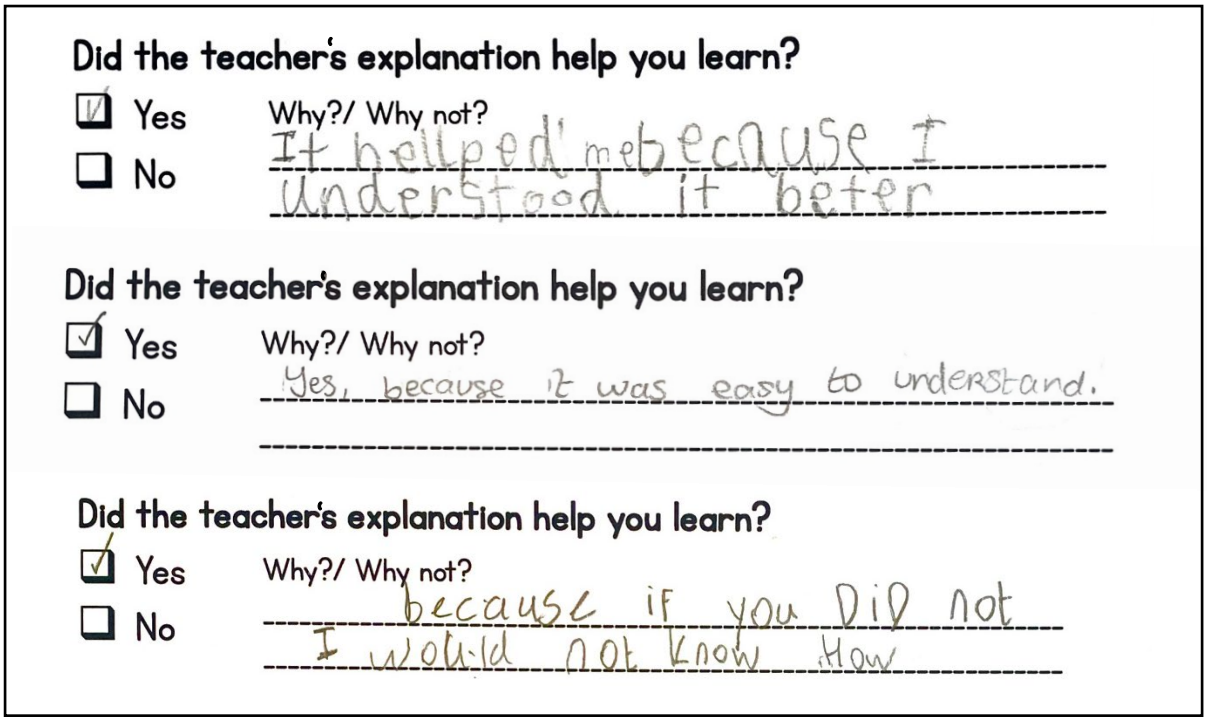


Figure 4.8: Written Survey 2 Question: 'Did the teacher's explanation help you learn?

From my own observations it was noticeable that the children focused and took part during time spent on direct instruction. Children appeared to enjoy working on their mini whiteboards and participating. It was a very interactive and active approach as the children

were involved and actively thinking as the teacher explained. This was evident as the children showed their mini whiteboards to the teacher and to each other to explain their thinking.

In the interviews the value the children placed on the role of the teacher was evident in interviews 6 and 7 in Appendix V. Children valued teachers who explained things to them, were positive, kind and helped them when they were struggling; Child 2 said “it’s good to know like… that if you are stuck you can ask for help.” When asked what a good teacher might do in the classroom, Child 13 suggested “explaining stuff that you don’t know”. In end of intervention survey all of the children (n = 16) responded that they found the teacher’s explanations helped them to learn in mathematics.

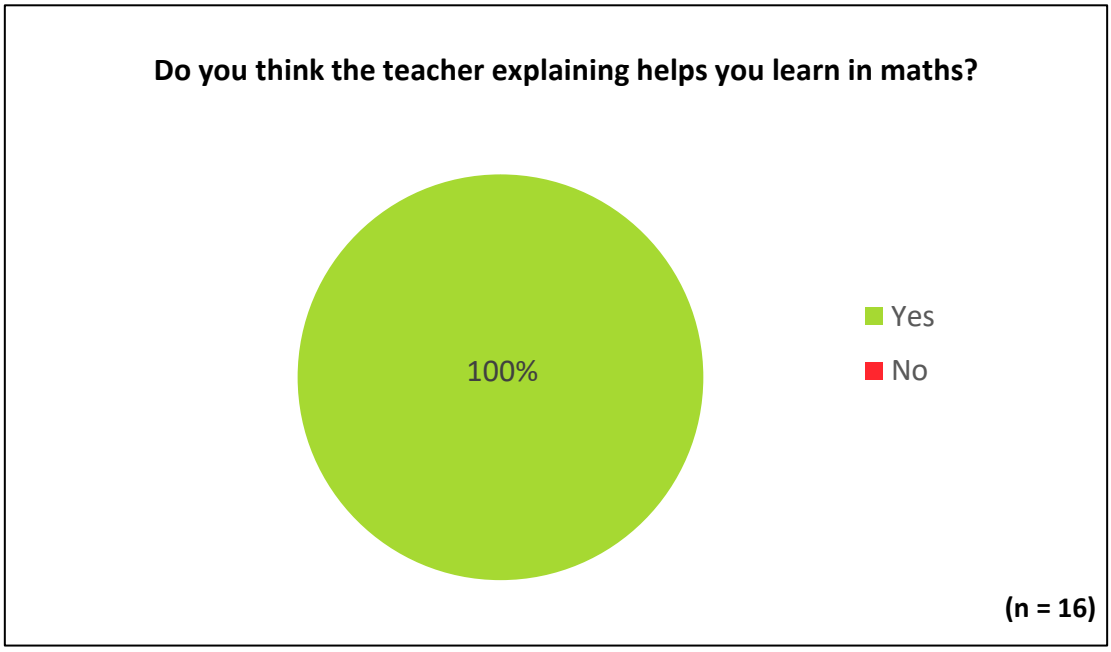


Figure 4.9: End of Intervention Survey Question: ‘Do you think the teacher explaining helps you learn in mathematics?’

Another question in the end of intervention survey asked the children to share their feelings during teacher explanations. The children could choose from a selction of responses or add

their own feelings. As evidenced in Figure 4.10. the chidlren identified a range of feelings when listening to the teacher's explanations. The majority of children chose a combination of postive emotions. I think this gives a good indication of the different emotions the children in my class felt during direct instruction. Understandably,some children find mathematics more difficult and learning new concepts can be stressful and challenging. This is evident from the response of one child who chose a mixture of both positive and negative emotions in the end of intervention survey. The child chose 'happy, stressed, confused and confident' which shows an awareness of feeling a range of emotions during mathematics.

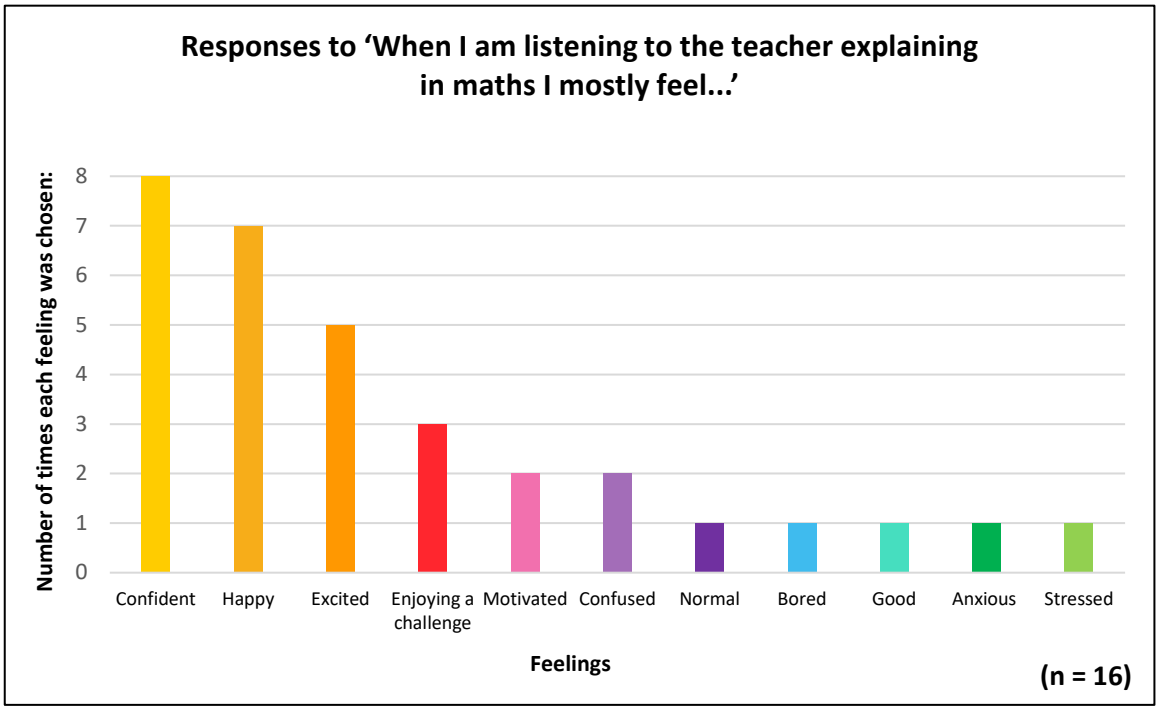


Figure 4.10: Results from End of Intervention Survey 'When I am listening to the teacher explaining in maths I mostly feel…'

4.4 Finding Three: Combining Playful Learning and Direct Instruction for Effective Teaching and Learning.

In my research question I asked, "how can I improve my teaching of mathematics by using a balance of direct instruction and playful learning?" As evidenced by the numerous examples in the previous two sections I found both playful learning and interactive direct instruction to be very beneficial in terms of my teaching and the children's learning. Combining both of these effective pedagogical approaches created an environment which enhanced children's learning experiences in mathematics. This led to a finding that using a balance of direct instruction and playful learning resulted in high impact instruction and effective learning.

Having a flexible approach was a third theme which emerged in the data analysis. My agency in being flexible and adaptable ensured high-quality teaching and learning. This meant selecting the most appropriate strategy to suit the class, topic or learning outcome. The 'Preparation for Teaching and Learning' document (Department of Education, 2021a: 9) echoes this finding that teachers should be flexible and agentic. "By making professional decisions based on a sound knowledge of pedagogy, of content and taking account of the interests, curiosities and prior learning of the children, teachers exercise their agency and efficacy". Critically, playful learning should be tailored by educators to align with their students' interests and experiences, as well as the specific academic standards they are expected to meet. There is also a significant emphasis on the need for teachers to be playful and to take a "more than one way" approach to teaching (Mardell et al., 2021). For each topic it was necessary to adapt and change the approach and to create activities that would support the children in achieving the learning outcomes while also allowing them to be playful and active in their own learning. As evidenced during the change in approach during Cycle 2 of the research it was important to be flexible in terms of what strategies were used

when. Teacher agency to choose the pedagogical approach that suited was key (Brough & Calder, 2012).

I observed the children becoming more confident and enjoying learning. Children gave positive feedback on their experiences in mathematics class for a variety of reasons. It was evident that they valued both the time spent playing games and the time spent listening to and engaging with the teacher. Figure 4.11 shows the responses to the question 'What helps you learn in mathematics?'. The children had the option to choose more than one answer and the most frequently selected options chosen were 'playing games' chosen by 14 of the 16 respondents and 'my teacher explaining what we are doing' which was chosen by 13 of the 16 respondents. As evidenced in Figure 4.11 children also chose 'working with a partner' and 'using mini whiteboards' which were strategies frequently implemented during interactive direct instruction.

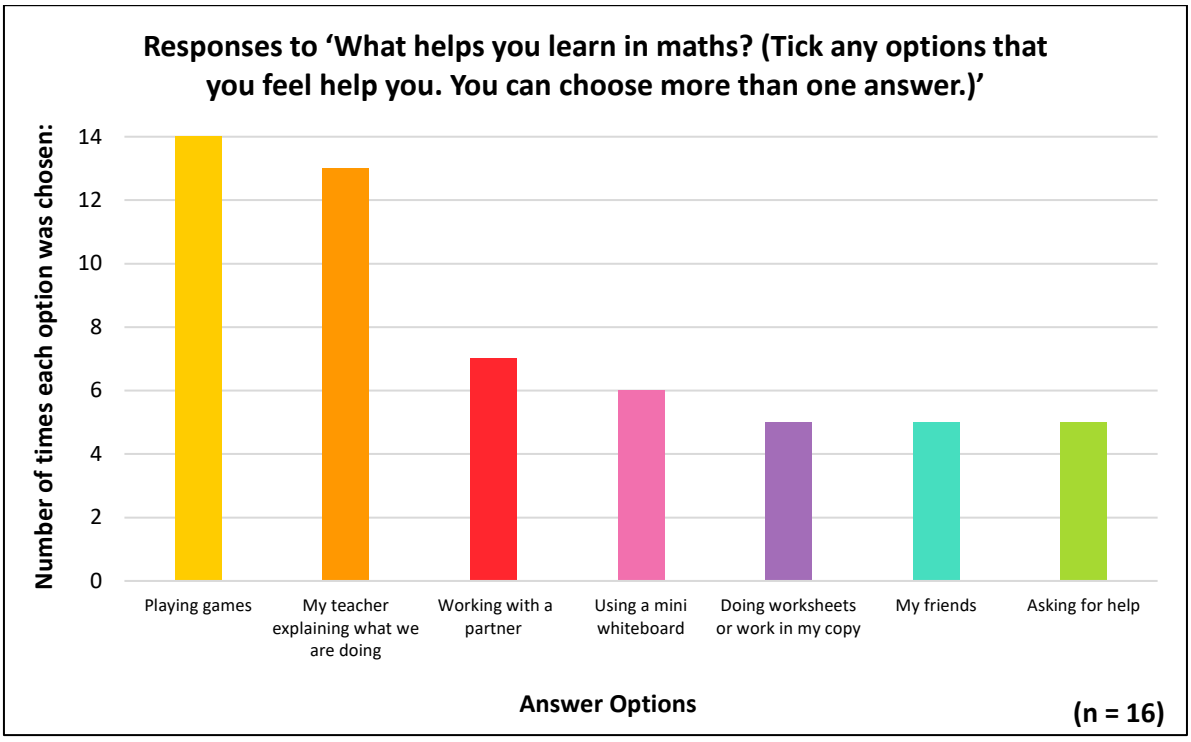


Figure 4.11: Results from End of Intervention Survey ''What helps you learn in mathematics?"

Using both direct instruction and playful learning pedagogical approaches was an effective method to enhance children's learning. Children were supported and scaffolded in their learning during direct instruction and had the opportunity to explore and use their knowledge in an engaging and motivating way during playful learning. In the end of intervention survey the majority of the class (see Figure 4.12 below) felt more confident in their mathematical ability as a result of the work undertaken in the classroom in previous weeks. As this work involved a combination of both playful learning and direct instruction, I suggest this indicates that this flexible approach was helpful in enhancing my teaching and the children's learning.

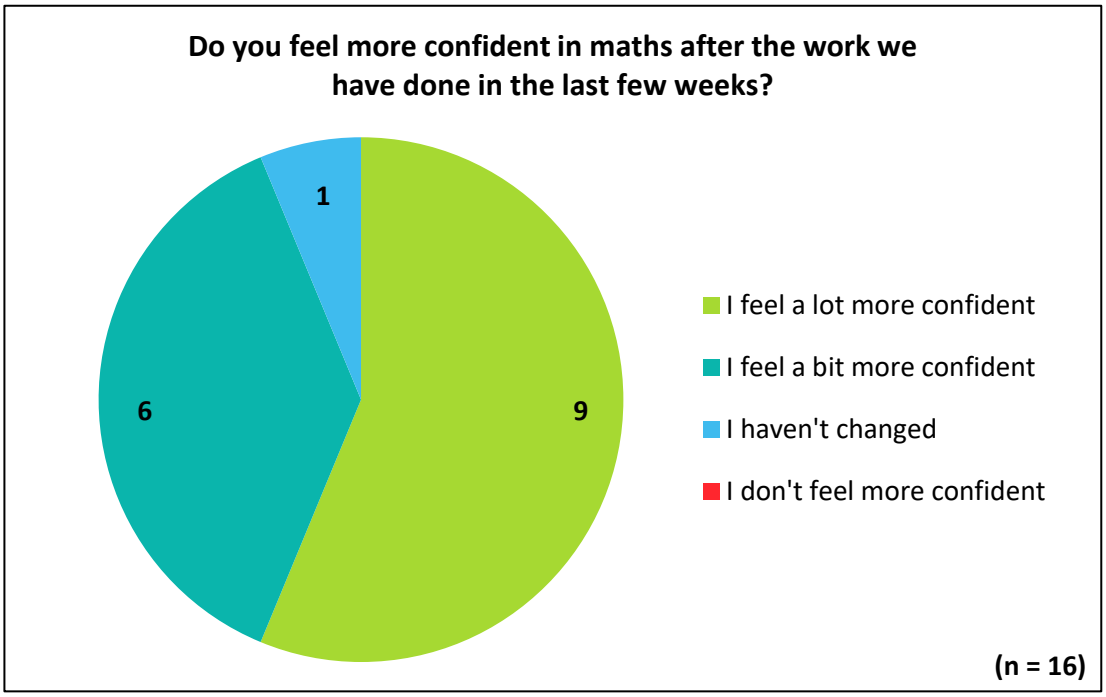


Figure 4.12: Results from End of Intervention Survey ''Do you feel more confident in mathematics after the work we have done in the last few weeks?"

4.5 Finding Four: Teacher Perspectives on Teaching Mathematics

The final finding relates to the role of the teacher within the wider Irish educational context. Teachers' surveys indicated that approximately 40% of Irish teachers feel they lack confidence and mathematical knowledge to teach mathematics in the senior classroom and rely on traditional methods such as direct instruction and the textbook. Throughout this section I consider the teachers' responses and relate their experiences and suggestions to my own classroom practice through my reflections.

As part of the research, I surveyed teachers about their perspectives on mathematics education in the senior primary classroom. The survey was carried out on my Instagram page 'Michelle's Innovative Ideas' (see Section 3.8.1). The survey was carried out on May 19th, 2022, and the full results are in Appendix VIII. There was a significant response rate to the survey with approximately 1,936 responses to each multiple-choice question. To put the number of responses in context I note that in 2020 there were 23,460 mainstream classroom teachers (Department of Education, 2021b). The survey was aimed at senior mainstream classroom teachers. Assuming there are approximately the same number of junior and senior mainstream teachers this would mean there are approximately 11,730 senior mainstream teachers. A response rate of approximately 1,900 teachers means that the survey may represent approximately 17% of current senior mainstream teachers. As a result of these high response rates, it is evident that the data is reflective of a large cohort of Irish primary teachers. The demographic of my Instagram audience is primarily between the age range of 22 – 44 with 93.9% female and 6.1% male.

4.5.1 Teacher Confidence and Knowledge in Teaching Mathematics.

When asked "Do you feel confident teaching mathematics in the senior classroom?" as depicted in Figure 4.13 (n = 1,973), the survey indicated that 59% (1,160 respondents) did feel confident teaching mathematics. Notably, however, the survey also revealed that 41% (813 respondents) of currently practising teachers do not feel confident teaching mathematics in the senior classroom.

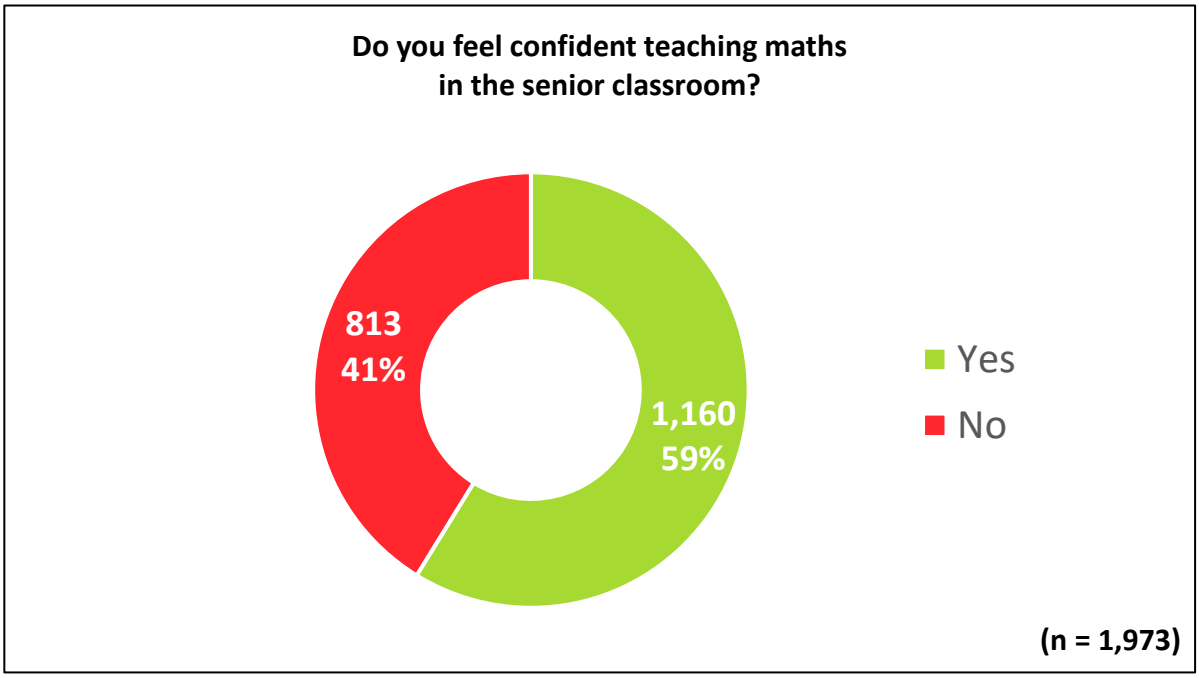


Figure 4.13: Results from Instagram Survey Question: "Do you feel confident teaching mathematics in the senior classroom?"

This survey also revealed that a large proportion of the teacher respondents felt they did not have the required knowledge to be able to teach mathematics effectively in the senior primary classroom. As evidenced in Figure 4.14 (n = 1,888), 37% of teachers (699 respondents) indicated that they did not have the mathematical knowledge to teach mathematics effectively in the senior classroom. While a significant proportion of respondents (1189 respondents/ 63%) felt confident in their knowledge, the large proportion

who feel they do not have the necessary mathematical understanding to teach mathematics in the senior classroom remains a concern.

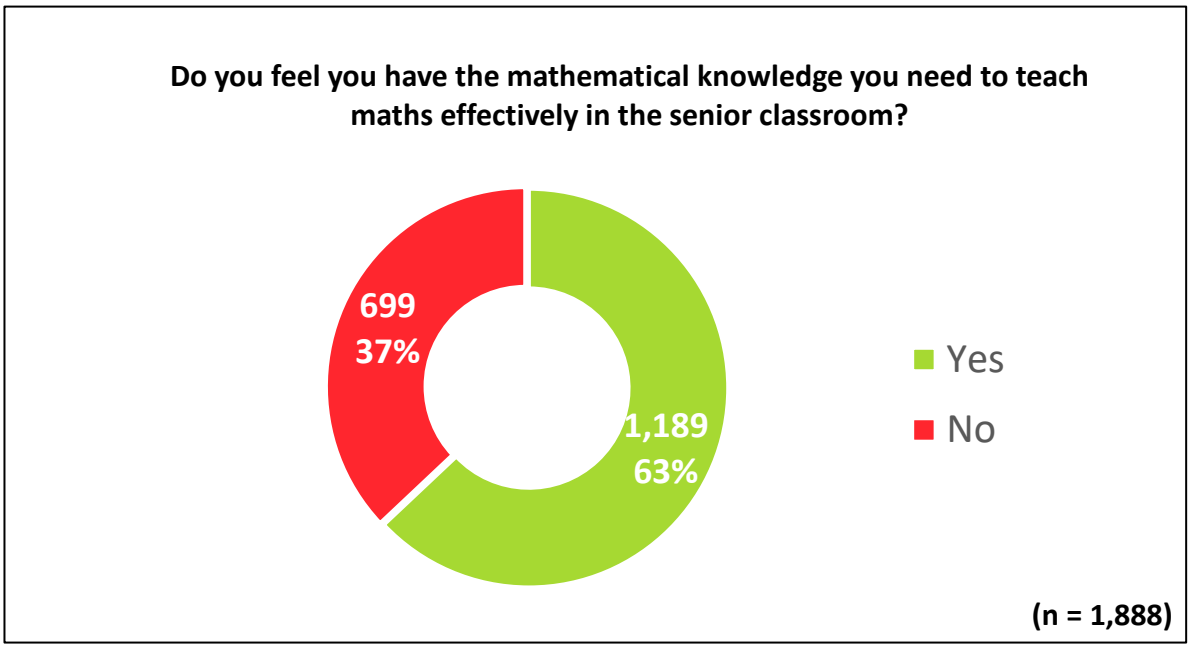


Figure 4:14: Results from Instagram Survey Question: "Do you feel you have the mathematical knowledge you need to teach mathematics effectively in the senior classroom?

As outlined in Section 2.3.4 teacher knowledge is the foundation upon which pedagogy rests (Shulman, 1986; Ball et al, 2008). The above results from the Instagram teacher survey suggest that there is a large cohort of currently practising teachers who need support in teaching mathematics. Teachers who are not confident and feel they lack mathematical knowledge may not have the capacity to provide high quality mathematical teaching. As noted by Murphy et al. (2011) teachers who possess robust mathematical knowledge demonstrate a higher quality of mathematical teaching and are better able to cater for a variety of learning needs.

4.5.2 Use of the Textbook in Teaching Mathematics

In the course of my action research intervention with 4th class I found that in purposefully planning for teaching I relied less on the textbook and engaged the class in a variety of playful

learning activities. In my own practice this move away from the textbook was described in a reflective task completed as part of a module in my coursework. In contrast, a large proportion of the survey respondents used the textbook frequently while playful learning was used infrequently.

As illustrated in Figure 4.15 (n = 2,213), 84% of the respondents (1,855 teachers) used the textbook every day or most days. However, only 16% (358 teachers) used the book once or twice a week or rarely.

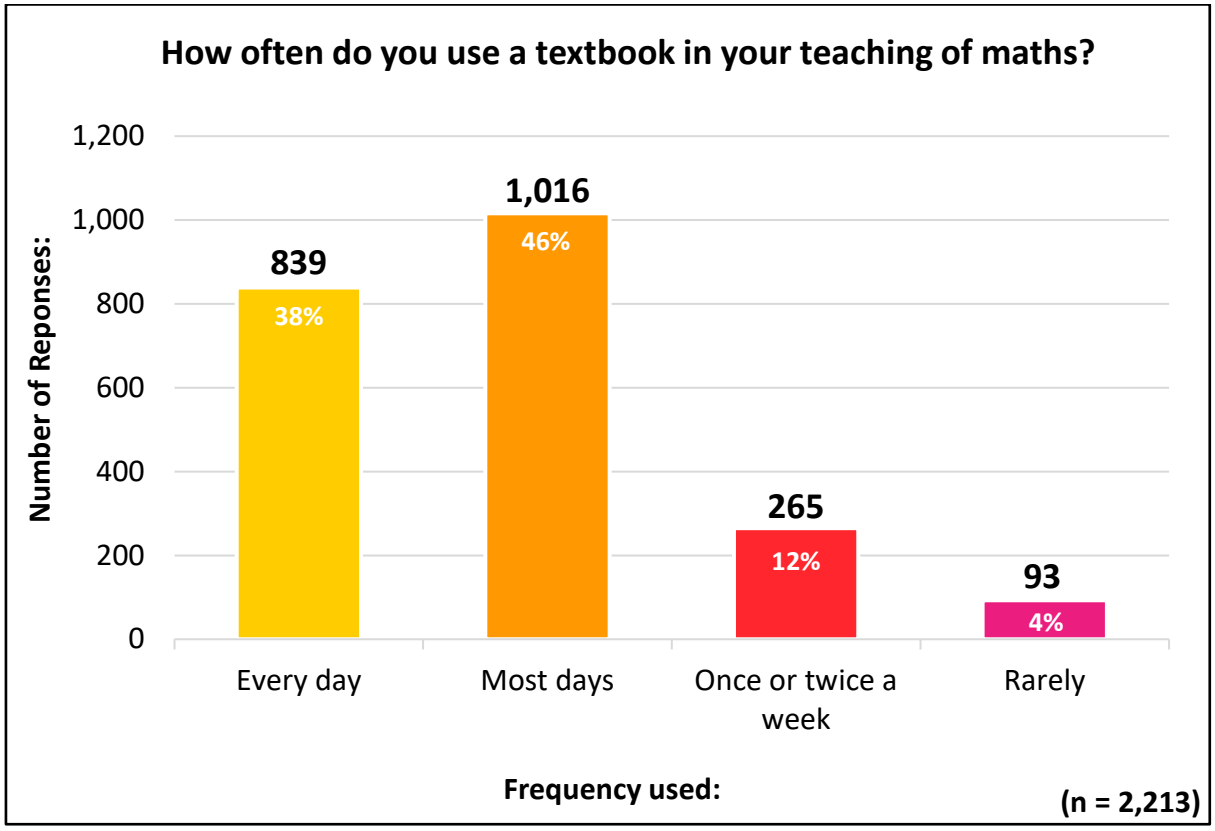


Figure 4.15: Results from Instagram Survey Question: "How often do you use a textbook in your teaching of mathematics?

As mentioned above, during the period of my intervention, I found I used the textbook more infrequently as I spent time critically analysing what my class needed to learn and teaching those concepts directly. At times, I noticed that the activities in the textbook did not align

with what I planned to teach based on the curriculum objectives (NCCA, 1999). Moreover, on some occasions there were a limited number of questions on a topic, and I felt that more repetition of a skill was needed. I therefore organised a worksheet or wrote additional questions on the whiteboard. However, I note that it took significant time to design or select activities to help children achieve the learning outcomes.

The textbook was useful as a resource to know what types of questions would be suitable. It was also a useful resource as supplementary material for early finishers when the questions were suitable. By using my professional autonomy, I was able to identify which elements of the textbook would supplement the children's learning. I would recommend that teachers use the textbook judiciously and be aware of when additional practice of a skill is needed. Moreover, there are times when the textbook may not line up with the children's ability. In this case using a textbook will cause stress for the teacher and children. In my research this was evident in the topic of time when the children needed additional support to achieve objectives at a lower level. Conversely, they needed more challenging questions in relation to multiplication with decimals. This links with the theme of teacher agency and flexibility which emerged in the research.

4.5.3 Playful Learning in Teaching Mathematics in an Irish Educational Context

As depicted in Figure 4.16 (n = 2021), games and playful learning were used infrequently by the teachers who responded to the survey. Only 11% (222 teachers) of respondents used playful learning every day and 29% (577 teachers) used it most days. However, 1,222 teachers used it once or twice a week or rarely which indicates that 60% of teachers do not frequently incorporate playful learning activities as a key teaching pedagogy in the senior primary classroom.

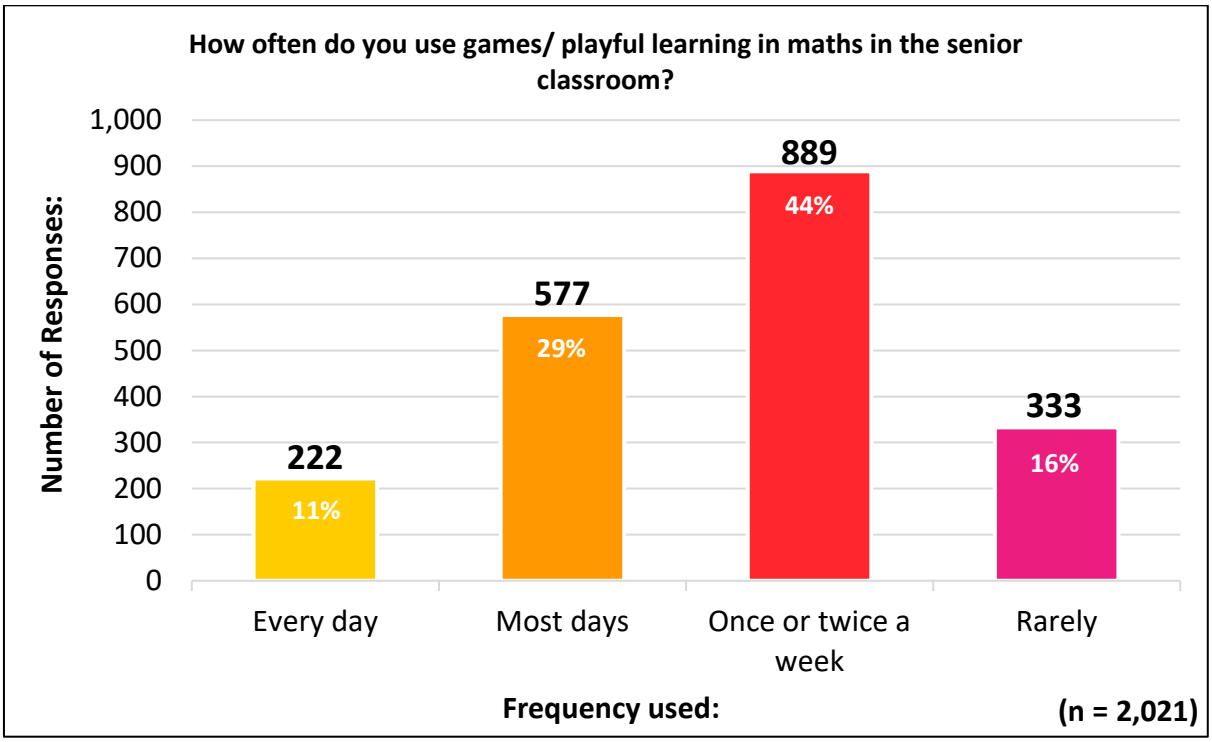


Figure 4.16: Results from Instagram Survey Question: "How often do you use games/ playful learning in the senior classroom?"

Interestingly, teachers felt they used active learning more often than games/playful learning. As I re-evaluated my understanding of playful learning to encompass many active learning activities, teachers may not realise the active learning activities in their classrooms falls under the continuum of playful learning as described by Zosh et al. (2017). Nonetheless, there were a significant proportion of teachers who only use active learning once or twice a week or rarely.

4.5.4 Irish Teachers' Perceptions of the Role of the Teacher

This study found that the role of the teacher is essential in teaching mathematics as noted in Section 4.2.2, where the role of the teacher is outlined, a concept which is backed by research such as (Muijs & Reynolds, 2000; Hattie et al., 2017; Rosenshine 2012; Haylock, 2019;). This was also reflected in the Instagram survey results in Figure 4.17 (n = 1,868), where 87% of respondents (1,630 teachers) felt the role of the teacher was very important and 12% felt

the role was important (232 teachers). In contrast, less than one percent (0.004%) of teachers (6 respondents) felt that the teacher did not play an important role in mathematics teaching.

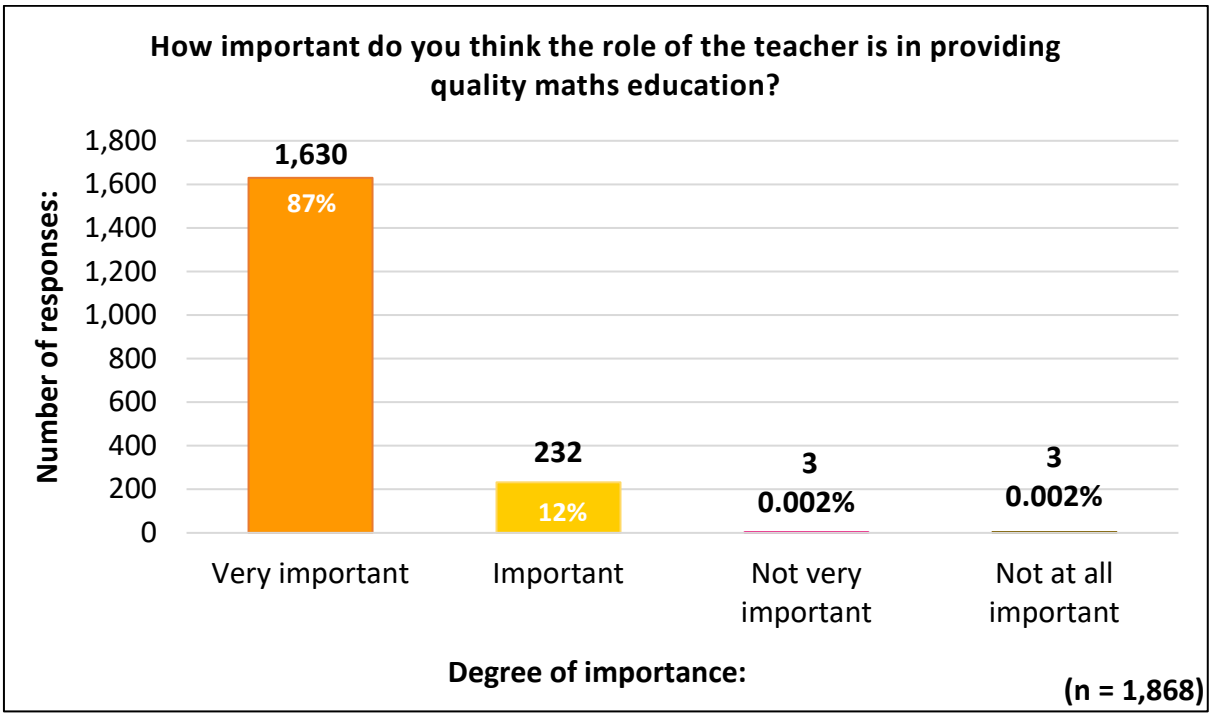


Figure 4.17: Results from Instagram Survey Question: "How often do you use games/ playful learning in the senior classroom?"

In addition, 83% of teachers (1,461 respondents) said that they spent a lot of time explicitly teaching where the children are listening and they are modelling examples which represents a more traditional, instructionist view of direct instruction than the model of interactive direct instruction adapted in this research. Despite this, in their written responses to the Instagram survey teachers created a vibrant picture of what effective mathematics teaching looks like in a senior classroom with the most common themes including children engaged in active learning, engaging in maths talk, teacher modelling, using concrete resources and using real life examples (See Appendix VII). However, a dichotomy exists between this ideal vision of an effective classroom and reality as evidenced by the previous graphs which depict that a large proportion of teachers use the textbook and direct instruction as their key means

of teaching while placing less of an emphasis on playful or active learning. This concept reflects Skott's (2008) thoughts on belief enactment. Teachers know what they want to achieve in terms of a child-centred approach as evidenced in their written responses but difficulties such as time constraints to cover the curriculum and differentiating for a wide range of abilities were cited as the difficulties teachers faced when teaching mathematics in the senior classroom, (See Appendix VII) which is evidently impacting on teachers' ability to teach in a way they feel is effective.

4.5.5 Conclusion

It is evident that a large proportion of Irish teachers value and acknowledge the importance of the teacher in teaching mathematics effectively, a concept which is alluded to my many theorists such as Murphy et al., (2011), Hattie et al. (2017), Shulman (1986), Kaskens (2020) and Kirschner et al., (2006). Notwithstanding, the survey results also suggest that some teachers may be relying on the textbook to teach mathematics as they feel they don't have confidence or sufficient knowledge. In addition, a high proportion of the teachers surveyed frequently use a textbook and infrequently use playful learning. It may therefore be the case that a textbook laden, didactic approach to teaching mathematics is being used in these classrooms. As previously described, I placed less emphasis on using the textbook and found that using a balance of playful learning approaches complemented by teacher-led interactive direct instruction led to effective teaching and learning in mathematics.

Chapter Five: Conclusions and Recommendations:

5.1 Introduction

This research brings together two seemingly contrasting approaches to teaching mathematics in the senior classroom: direct instruction and playful learning. Analogous to Schoenfeld (2004), the data suggests that learning does not need to be exclusively 'teacher-directed' or 'child-centred'. Instead, using the most beneficial parts of both approaches can positively impact on children's learning and attitudes to mathematics. Playful learning can be used to teach, extend and revise content and it enhances children's motivation and engagement. Using direct instruction to explicitly teach topics and scaffold learning for children is effective in helping them achieve learning outcomes. I found that flexibly using both pedagogies was effective in enhancing my teaching of mathematics. Through implementing the findings that are presented in this study, I believe my approach to teaching mathematics will enhance children's learning experiences. In a wider Irish educational context, I found that many teachers indicated that they lack confidence in their teaching abilities and feel they lack the knowledge to teach mathematics effectively. I recommend that the methodologies of direct instruction and playful learning are shared as effective teaching strategies through their inclusion in the upcoming mathematics curriculum and that CPD is developed for primary teachers to facilitate upskilling in mathematics education.

5.2 Implications for my Personal Practice

Flexibly using the pedagogical approaches of playful learning and direct instruction enhanced the teaching and learning experiences of mathematics in my classroom and going forward I will continue to use both approaches in my teaching. I have a greater understanding of the

scope and benefits of playful learning from the literature and from reflecting on my own practice. I understand the potential benefits of using a playful learning pedagogy in terms of motivating learners, developing understanding of new concepts and using play as a strategy to help children achieve learning outcomes. After examining the literature, I am more confident in my assertion that there is a place for playful learning in the senior classroom.

Furthermore, as discussed in Section 2.4 playful learning is accessible for learners at all stages of life. While research on play tends to generally focus on free play in early years education as evidenced by the focus on early years by many researchers (Fuller et. al, 2017; Kamii, 2015; Walsh et al., 2006; Martlew et al.,2011), my findings suggest that there is a place for play in the senior primary classroom. Playful learning was an integral part of my intervention had several key educational and emotive outcomes as described in Section 4.2. I suggest that a discussion about the different types of play, encompassing free play, guided play, games and playful direct instruction (Zosh et al., 2018) would be beneficial in terms of cultivating a wider understanding of what 'play' can mean in education. I recommend that playful learning strategically combined with direct instruction can form a key pedagogical approach for teaching mathematics at all levels of primary education in Ireland.

Another key takeaway in terms of my professional practice will be in actively seeking the children's voices more frequently. Having small group interviews gave me a great insight into how the children were feeling and it gave them an opportunity to share their thoughts on their education.

As a result of engaging in a self-study action research approach I have embraced self-reflection and believe that there is a place for reflexively examining practice and identifying areas of potential conflict where I might be experiencing a living contradiction between my practice and beliefs (Whitehead, 2010). As a result of engaging in this action research study

I have come to understand and value reflexively examining my personal practice. Action research is an ongoing process and I plan to continue to improve my practice through informal action research cycles.

I continue to value the role of the teacher and suggest that using interactive direct instruction can work in tandem with a child-centred, constructivist approach to teaching. Time where the teacher is explicitly teaching new concepts is balanced with time for children to share their thoughts and ideas, explore concepts in pairs and engage in playful learning. In my own practice I will be placing an emphasis on both playful learning and on interactive direct instruction during my teaching in the future. At the outset of the research, I struggled to reconcile the two approaches as they seemed to be contrasting: one very child-centred approach and one teacher-led. However, upon consulting the literature and describing what direct instruction is in my context I realised that both pedagogical approaches can work in tandem to provide quality educational experiences for children, a value which is essential to me as an educator.

I also aim to use the knowledge I have cultivated throughout this research to create CPD for teachers. I envision that this will include the provision of practical support for teachers to develop the different types of mathematical knowledge as described by Shulman (1986), which was previously outlined in Section 2.3.4 as well as sharing practical ideas and resources that can be used in the classroom to facilitate the use of playful learning and interactive direct instruction pedagogies informed by the primary mathematics curriculum (NCCA, 2022).

5.3 Implications for Curriculum Development

In my research I found that direct instruction and playful learning complement each other to create an effective environment for mathematics teaching and learning. Despite the fact that

numerous sources examined in the literature review, do not recommend an exclusively constructivist curriculum (NMAP, 2008; Kirschner et al., 2006; NRC, 2001), the recent Irish curricula (NCCA, 1999; NCCA, 2022) are purely constructivist and as such lean heavily on a child-centred approach. Playful learning is suggested as a prefix for learning outcomes in only junior and senior infants and the role of the teacher is not described in the curriculum (NCCA, 2022). The draft mathematics curriculum (NCCA, 2022: 25) outlines "five key pedagogical practices": promoting maths talk, using cognitively challenging tasks, fostering productive disposition, using formative assessment and emphasising mathematical modelling.[4] I suggest that the pedagogical approaches of playful learning and interactive direct instruction directly underpin many of these key pedagogical approaches as envisioned in Figure 5.1.

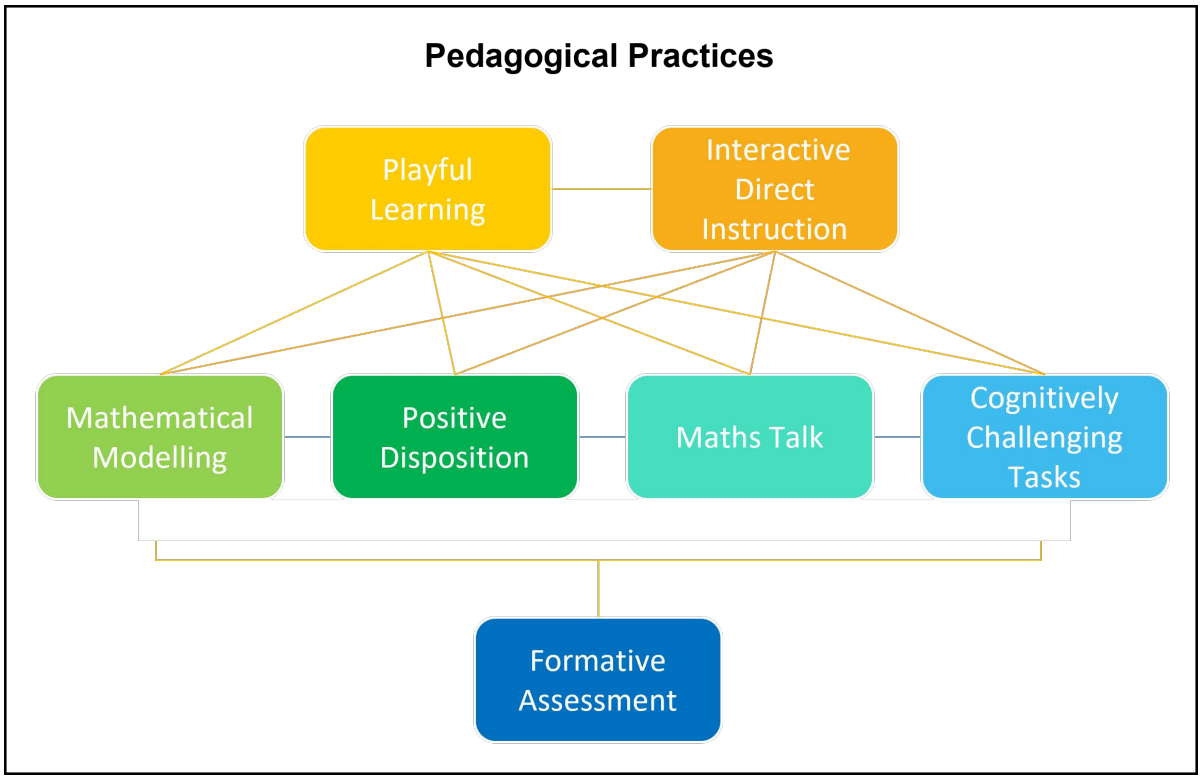


Figure 5.1: Linking the pedagogies of playful learning and interactive direct instruction to the five key pedagogies outlined in the draft primary mathematics curriculum.

[4] In the draft curriculum mathematical modelling is a child centred approach referring to the child creating their own models "through a process of testing, revising and expressing their interpretation of different mathematical ideas, experiences, problems and situations" (NCCA, 2022: 30). This is fundamentally different to teacher modelling which has previously been described as part of the role of the teacher, where the teacher is explicitly teaching or demonstrating a concept. In the curriculum it is suggested that teachers can facilitate mathematical modelling by "refraining from imposing personal models and particular paths to a solution" (NCCA, 2022: 30).

Throughout my intervention children were fostering a positive disposition, experiencing math talk and engaged in challenging tasks. Assessment also played a key role in establishing the children's prior knowledge and in the reflecting and adapting teaching to suit the needs of the class as described within the role of the teacher in Section 4.3. Through engaging in both playful learning and direct instruction the children were experiencing many of the key pedagogical approaches suggested and as such I believe they could be included as pedagogies which underpin and supplement the other pedagogies as envisioned in Figure 5.1. As evidenced from the data gathered during my intervention the inclusion of these pedagogies would enhance teaching and learning in the curriculum. As teachers have indicated there is a reliance on using a textbook and direct instruction (see Section 4.5.2) use of more familiar pedagogical approaches such as interactive direct instruction could support teachers in moving from their current practice to some of the envisioned pedagogical approaches as suggested in the draft mathematics curriculum (NCCA, 2022)

5.4 The Role of the Teacher in the Curriculum

Throughout my action research, during my teaching, in the analysis of the data and in reflexively drawing findings, the role of the teacher was of paramount importance. Irish teachers have shown that they value the role of the teacher in education as evidenced previously in Figure 4.16, with 1,862 teachers (99.7% of respondents) suggesting that the role of the teacher was 'very important' or 'important'. It is essential that the curriculum reflects this key value that Irish teachers hold. As such, I suggest that the curriculum explicitly describes the role of the teacher in facilitating the pedagogies outlined in the curriculum. Additionally, I suggest that interactive direct instruction and playful learning are included as valuable pedagogical approaches in mathematics education. Furthermore, I contend that a

purely child-centred curriculum where the children are asked to discover the ideas themselves with the teacher only facilitating the learning will not be practical or successful as evidenced in Section 2.3.3. The teacher should have a role in teaching content through direct instruction (Kirschner et al., 2006), which is envisioned to be an interactive and engaging process (Hattie et al., 2017). Schoenfeld (2004: 257) notes that "for a curriculum to succeed it needs to be made accessible to various constituencies and stakeholders". Teachers' values should be reflected in the curriculum and teachers need to feel prepared and confident in how to use a curriculum or they will either avoid using it or only use elements of it (Schoenfeld, 2004). This is evidenced in the Irish context by O'Shea and Leavey (2013: 312) who found that teachers "developed significant reservations about the employment of constructivism in the classroom". The teachers who were involved in the study shared their values as encompassing the role of the teacher (O'Shea & Leavey, 2013). A purely constructivist or child-centred approach may not place enough value on the role of the teacher. As previously explored in Section 2.3.4, the role of the teacher is essential in providing high quality mathematics education and it is evident from Section 4.5.4 that many Irish teachers do not embrace a purely constructivist approach as suggested in recent Irish curricula (NCCA, 1999; NCCA,2022). Nonetheless, I do believe that the child should also play a central role in their own learning as evidenced in the interactive approach to direct teaching recommended and the centrality of playful learning in my approach. The data suggests that teachers need to use their professional judgement and be flexible in choosing the most suitable pedagogical approach that will enhance their teaching and suit the learning needs of the children in their classroom (NMAP, 2008; NRC, 2001; Schoenfeld, 2004).

5.5 Recommendations

Playful learning and interactive direct instruction are valid and appropriate pedagogies which can be used to enhance teaching and learning in the senior primary classroom. I recommend that teachers flexibly use both pedagogical approaches in their teaching of mathematics.

In addition, I recommend that the NCCA consider the pedagogical approaches of playful learning and direct instruction among their key pedagogical practices suggested for use in the curriculum. As demonstrated in Figure 5.1 they link with the currently suggested pedagogies and could support teachers in moving from their current practice to some of the envisioned pedagogical approaches. In creating curricula, the values of the teachers should be a significant consideration in curriculum development and accurate and adequate representation of teachers and schools is essential.

Topics in mathematics should be taught iteratively and recursively (Hattie et al., 2017; Roshenshine, 2012). I observed that children in my classroom needed opportunities to encounter topics and concepts on a number of occasions to develop their conceptual understanding. This is reflected in the draft mathematics curriculum thorough the representation of learning outcomes across four stages (NCCA, 2022) and is an essential part of providing effective mathematics teaching.

I suggest that teachers need opportunities to upskill in mathematics (Willingham, 2009; Murphy et al., 2011) and that practical CPD be developed to support teachers in enhancing their mathematical knowledge and their content knowledge for teaching (Shulman, 1986). Without adequate content knowledge and pedagogical knowledge teachers will be unable to provide effective mathematics instruction (Murphy et al. 2011), a key consideration of the research question, which will have a direct impact on children's learning (Hattie et al., 2017). As such, CPD should provide practical and useful ideas that teachers can use or adapt for use

in their own classrooms. A bank of practical ideas and resources which detail activities that teachers can use to teach each topic should be developed to support the curriculum. Practical and useable ideas that are readily available alongside pedagogical knowledge may help teachers reduce their reliance on the textbook to teach mathematics.

5.6 Concluding Statement

This action research study has been a journey of self-discovery. I critically examined my own practice with a reflexive lens and identified the conundrum of using both teacher-led and child-centred approaches. In the intervention I used elements of both pedagogies flexibly to teach mathematics to meet my values of providing high quality teaching and learning experiences while also providing opportunities for children to be playful and active in their learning. I found that the children in my classroom were actively engaged in their learning and the approach enhanced my teaching and the children's learning. Having read and analysed the literature and considered my role in providing professional development courses for teachers I feel more informed in terms of providing ideas and CPD in relation to mathematics education in the future. I believe that playful learning and direct instruction are effective pedagogies that can be used in the senior primary classroom and that the role of the teacher should be highlighted as a critical influence on children's learning.

Bibliography

Alkan, V. (2013). *Reducing mathematics anxiety: The ways implemented by teachers at primary schools in Turkey*. International J. Soc. Sci. & Education, 3(3), 795-807.

Baker, D. F., & Baker, S. J. (2012). *To "catch the sparkling glow": A canvas for creativity in the management classroom.* Academy of Management Learning & Education, 11(4), 704- 721.

Ball, D., Thames, M. H. and Phelps, G. (2008) *Content Knowledge for Teaching: What Makes It Special?* Journal of Teacher Education Vol. 59, no. 5, pp. 389-407.

Bergen D. (2018) *Cognitive Development in Play-Based Learning.* In: Tremblay RE, Boivin M, Peters RDeV, eds. Pyle A, topic ed. Encyclopaedia on Early Childhood Development [online]. Available at: https://www.child-encyclopedia.com/play-based-learning/according-experts/cognitive-development-play-based-learning (Accessed 24 November 2021)

Boaler, J. (2002) *Experiencing School Mathematics: Traditional and Reform Approaches to Teaching and Their Impact on Student Learning*, Revised and Expanded Edition Taylor & Francis Group.

Borko, H., & Whitcomb, J. A. (2008) *Teachers, Teaching, and Teacher Education: Comments on the National Mathematics Advisory Panel's Report.* Educational Researcher, *37*(9), 565–572. http://www.jstor.org/stable/25209056

Boxer, A. ed. (2019) *The ResearchED Guide to Explicit and Direct Instruction: An Evidence-Informed Guide for Teachers,* John Catt Educational. ProQuest E-book Central, https://ebookcentral.proquest.com/lib/nuim/detail.action?docID=6268106

Brantlinger, A. (2011) *Rethinking critical mathematics: a comparative analysis of critical, reform, and traditional geometry instructional texts.* Educational Studies in Mathematics, *78*(3), 395–411. http://www.jstor.org/stable/41485960

Brookfield, S. D. (2017). *Becoming a critically reflective teacher* (2nd ed.). Jossey-Bass.

Brough, C. & Calder, N. S. (2012). *Mathematics as it happens: Student-centred inquiry learning.* In J. Dindyal, L P. Cheng & S. F. Ng (Eds), Mathematics education: Expanding horizons (Proceedings of the 35th annual conference of the Mathematics Education Group of Australasia [eBook], pp. 138-145). Singapore: MERGA.

Brown, S. L. (2009) *Discovering the Importance of Play through Personal Histories and Brain Images: An Interview with Stuart L. Brown*. American Journal of Play, v1 n4 p399-412 Spr09

Brown, S. L. (2010) *Play: How it Shapes the Brain, Opens the Imagination, and Invigorates the Soul.* New York, NY: Penguin Group.

Brydon-Miller, M. (2009) *Covenantal Ethics and Action Research: Exploring a Common Foundation for Social Research. In:* The Handbook of Social Research Ethics, Thousand Oaks, CA: SAGE Publications, Inc. pp. 243-258. Available at: <http://www.doi.org.jproxy.nuim.ie/10.4135/9781483348971> [Accessed 1 Jan 2022]

Brydon-Miller, M., Greenwood, D. and Maguire, P. (2003) *'Why Action Research?', Action Research,* 1(1), pp. 9–28. doe: 10.1177/14767503030011002. Link: https://journals.sagepub.com/doi/pdf/10.1177/14767503030011002

Central Statistics Office (2022) *Arrivals from Ukraine in Ireland Series 4* [online] Available at: https://www.cso.ie/en/releasesandpublications/fp/p-aui/arrivalsfromukraineinirelandseries4/ (accessed 1st September 2022)

Clarke, V. & Braun, V. (2013) *Teaching thematic analysis: Overcoming challenges and developing strategies for effective learning.* The Psychologist, *26*(2), 120-123. https://www.researchgate.net/publication/269928387_Teaching_thematic_analysis_Overcoming_challenges_and_developing_strategies_for_effective_learning

Cochrane, J. (2005) *Can You Really Learn Basic Probability by Playing a Sport Board Game?* American Statistician, 59 (3), 266-272.

Cohen, L., Manion, L. & Morrison K. (2018) *Research Methods in Education* Vol. Eighth edition. Routledge. https://web-s-ebscohost-com.jproxy.nuim.ie/ehost/ebookviewer/ebook/bmxlYmtfXzE2MTQ2MzRfX0FO0?sid=c3f4788e-b5c6-4a38-bee6-3228e3aa9ed2@redis&vid=0&format=EB&lpid=lp_202&rid=0

Dale, R. and Scherrer, J. (2015) *'Goldilocks Discourse--math scaffolding that's just right'*, *Phi Delta Kappan*, 97(2), 58, Sage Publications Ltd. Available at: https://link.gale.com/apps/doc/A434296320/ITOF?u=nuim&sid=summon&xid=95c59699 (accessed 22 Nov 2021)

DCYA (2012) *Guidance for developing ethical research projects involving children.* Dublin: Government Publications.

DCYA (2011) *Children First: National Guidance for the Protection and Welfare of Children, Department of Children and Youth Affairs.* Dublin: Government Publications. Available at: www.dcya.gov.ie/documents/ child_welfare_protection/ChildrenFirst.pdf

Delaney, S., Ball, D.L., Hill, H.C. (2008) *Mathematical knowledge for teaching: Adapting U.S. measures for use in Ireland.* J Math Teacher Educ. **11,** 171–197 https://doi-org.jproxy.nuim.ie/10.1007/s10857-008-9072-1

Department of Education (2021a) *Preparation for Teaching and Learning - Guidance for All Primary and Special Schools.* Dublin: Ireland https://www.gov.ie/en/publication/95ff5-preparation-for-teaching-and-learning-guidance-for-all-primary-and-special-schools/

Department of Education (2021b) *Educational Indicators for Ireland.* Dublin: Ireland https://www.gov.ie/en/publication/055810-education-statistics/

Department of Education (2022) *Statistical Bulletin – July 2022. Overview of Education 2001 – 2021.* Dublin: Ireland https://assets.gov.ie/230264/63fab8ce-a051-4004-a39a-3d4891f43833.pdf

Dewey, J. (1938). Education and democracy in the world of today. Schools (Chicago, Ill.), 9(1), 96-100. https://doi.org/10.1086/665026

Dooley, T. (2019) *Learning and Teaching Primary Mathematics. An Addendum to NCCA Research Reports 17 and 18* https://ncca.ie/media/4087/primary_mathematics_research_addendum_2019.pdf (accessed 8 June 22)

Duffy, T.M. & Cunningham, D.J. (1996) *Constructivism: Implications for the design and delivery of instruction. In D. Jonassen* (Ed.), Handbook of research for educational communications and technology (pp. 170-198). New York: Simon & Schuster.

Eberle, S.G. (2014) *The Elements of Play: Toward a Philosophy and a Definition of Play*, American journal of play, vol. 6, no. 2, pp. 214.

Farrokhi, F. and Mahmoudi-Hamidabad, A. (2012) *Rethinking convenience sampling: Defining quality criteria*. Theory & Practice in Language Studies, 2(4). https://d

Fisher, K. R., Hirsh-Pasek, K., Newcombe, N., & Golinkoff, R. M. (2013). *Taking shape: Supporting preschoolers' acquisition of geometric knowledge through guided play*. Child Development, 84, 1872-1878. doi:10.1111/cdev.12091

Fisher, D. and Frey, N., (2013) Gradual Release of Responsibility Instructional Framework. IRA E-ssentials, pp.1-8. doi:10.1598/e-ssentials.8037

Freire, P. (1921) *Pedagogy of the oppressed.* Translated by: Bergman Ramos, M. New York: Continuum.

Froebel, F., & Hailmann, W. N. (1887) *The education of man*. New York: D. Appleton.

Fuller, B., Bein, E., Bridges, M., Kim, Y., Rabe-Hesketh, Y. (2017) *Do academic preschools yield stronger benefits? Cognitive emphasis, dosage, and early learning,* Journal of Applied Developmental Psychology, Volume 52, Pages 1-11, ISSN 0193-3973, https://doi.org/10.1016/j.appdev.2017.05.001.

Garvey, C. (1990) *Play,* 2nd Edn. Cambridge, MA: Harvard University Press.

Gelling, L. and Munn-Giddings, C. (2011) *Ethical Review of Action Research: The Challenges for Researchers and Research Ethics Committees*, Research Ethics, 7(3), pp. 100–106. doi: 10.1177/174701611100700305.

Given, L. M. (2008). *The SAGE encyclopaedia of qualitative research methods*. SAGE Publications, Inc., https://dx.doi.org/10.4135/9781412963909.n318

Government of Ireland (2003) *Data Protection Act* Dublin: Ireland.

Hattie, J. (2009) *Visible learning: A synthesis of over 800 meta-analyses relating to achievement.* New York, NY: Routledge.

Hattie, J., Fisher, D., & Frey, N. (2017) *Visible learning for mathematics, grades K-12: what works best to optimize student learning.* Corwin: Sage Publications Ltd.

Hamilton, M.L., and Pinnegar S. (1998) *Conclusion: The value and promise of self-study.* In *Reconceptualizing teaching practice: Self-study in teacher education*, ed. Hamilton, M. L., 235–46. London: Falmer Press.

Haylock, D. (2010) *Mathematics explained for primary teachers.* 4th Edition. Sage.

Haylock, D. (2019) *Mathematics explained for primary teachers.* 6th Edition. Sage.

Henricks, T.S. (2015) *Play as Experience.* American Journal of Play, 8, 18-49.

Hirsh-Pasek K, Golinkoff R, Ever, D. (2003) *Einstein never used flashcards: How our children really learn and why they need to play more and memorize less.* Emmaus, PA: Rodale Press

Hirsh-Pasek, K., Golinkoff, R., (2008) *Why Play = Learning.* In: Tremblay RE, Boivin M, Peters RDeV, eds. Smith PK, topic ed. Encyclopedia on Early Childhood Development [online]. Available at: https://www.child-encyclopedia.com/play/according-experts/why-play-learning (Accessed 10 November 2021)

Hirsh-Pasek, K., Hadani, H. (2020) *A new path to education reform: Playful learning promotes 21st-century skills in schools and beyond.* Available Online https://www.brookings.edu/wp-content/uploads/2020/10/Big-Ideas_Hirsh-Pasek_PlayfulLearning.pdf (Accessed 7 June 2022)

Holton, D., Ahmed, A., Williams, H., & Hill, C. (2001). *On the importance of mathematical play.* International Journal of Mathematical Education in Science and Technology, 32(3), 401-415.

Hunt, T. E., & Maloney, E. A. (2022) *Appraisals of previous math experiences play an important role in math anxiety.* Ann NY Acad Sci. 00 1– 12. https://doi-org.may.idm.oclc.org/10.1111/nyas.14805

Johnson, G. M. (2009). *Instructionism and Constructivism: Reconciling two very good ideas.* International Journal of Special Education, 24(3), 90.

Kamii C. (2015) Play *and mathematics in kindergarten*. In: Fromberg DF, Bergen D, eds. Play from birth to twelve: Contexts, perspectives, and meanings, 3rd ed. New York: Routledge. 2015:197-206.

Kaskens, J., Segers, E., Goei, S. L., van Luit, J. E. H., & Verhoeven, L. (2020) *Impact of Children's math self-concept, math self-efficacy, math anxiety, and teacher competencies on math development.* Teaching and Teacher Education, 94, 1-14. [103096]. https://doi.org/10.1016/j.tate.2020.103096

Kelchtermans, G. (2009) *Who I am in how I teach is the message: self‐understanding, vulnerability and reflection*, Teachers and Teaching: theory and practice [online], 15:2, 257-272. Available at: https://doi.org/10.1080/13540600902875332 (accessed 8 March 2022)

Kelchtermans, G. (2018) *Professional Self-Understanding in Practice: Narrating, Navigating and Negotiating.* In: Schutz P., Hong J., Cross Francis D. eds. Research on Teacher Identity. Springer: Cham. Ch. 20.

Kirschner, P. A., Sweller, J., & Clark, R. E. (2006). *Why Minimal Guidance during Instruction Does Not Work: An Analysis of the Failure of Constructivist, Discovery, Problem-Based, Experiential, and Inquiry-Based Teaching.* Educational Psychologist, 41, 75-86.https://doi.org/10.1207/s15326985ep4102_1

Kemmis, S. (2009) *Action research as a practice-based practice,* Educational Action Research, 17:3, 463-474

Kemmis, S., & McTaggart, R. (1982). The Action Research Planner. Victoria: Deakin University Press.

Kuhn, T. (1962) *The structure of scientific revolutions.* Chicago, IL: University of Chicago Press.

Lin, F.-L. & Cooney, T. J. (2001) *Making sense of mathematics teacher education*. Springer.7e

Liu, C., Solis, L., Jensen, H., Hopkins, E., Neale, D., Zosh, J., Hirsh-Pasek, K., Whitebread, D. (2017). *Neuroscience and learning through play: a review of the evidence.* 10.13140/RG.2.2.11789.84963.

LaBoskey, V. K. (2004) *The methodology of self-study and its theoretical underpinnings In: J. J. Loughran, M. L. Hamilton, V. K. LaBoskey, and T. Russell., eds. International handbook of self-study of teaching and teacher education practices.* Dordrecht: Kluwer Academic Publishers.,817–869

Loughran, J. (2005) *Researching teaching about teaching: Self-study of teacher education practices.* Studying Teacher Education. 1, 5-16.

Lyons, N.P., & LaBoskey, V.K. (2002). *Narrative inquiry in practice: advancing the knowledge of teaching.*

Ma, X. (1999). *A Meta-Analysis of the Relationship between Anxiety toward Mathematics and Achievement in Mathematics.* Journal for Research in Mathematics Education, *30*(5), 520–540. https://doi.org/10.2307/749772

Mardell, B., Ertel, K., Solis, L., LeVangie, S., Fan, S., Maurere, G., and Scarpate, M. (2021) *More than one way: An approach to teaching that supports playful learning A Pedagogy of Play working paper*. Available at: http://pz.harvard.edu/sites/default/files/PoP%20USA%20More%20than%20one%20way%20working%20paper_FINAL_25%20Jan%202021.pdf (Accessed 23 November 2021)

Martlew, J.; Stephen, C.; Ellis, J. (2011) *Play in the primary school classroom? The experience of teachers supporting children's learning through a new pedagogy.* Early Years. 31 (1): 71–83.

Maynooth University (2018) Data Retention Schedule. Available at: https://www.maynoothuniversity.ie/sites/default/files/assets/document//Research%20Records%20Retention%20Schedule.pdf Accessed: 2nd Jan 2022

McDonagh, C., Roche M., Sullivan, B. and Glenn, M. (2012) *Enhancing Practice through Classroom Research: A Teacher's Guide to Professional Development.* Abingdon: Routledge.

McDonagh, C., Roche, M., Sullivan, B., & Glenn, M. (2019). *Enhancing Practice through Classroom Research: A Teacher's Guide to Professional Development* (2nd ed.). Routledge. https://doi.org/10.4324/9780429401091

McLeod, S. A. (2019) *Constructivism as a theory for teaching and learning*. Simply Psychology. www.simplypsychology.org/constructivism.html

McNiff, J. (2002) A*ction Research for Professional Development: Concise Advice for New (and Experienced) Action Researchers.* Dorset: September. Accessed at http://www.jeanmcniff. com/ar-booklet.asp

McNiff, J. and Whitehead, J. (2010) *You and Your Action Research Project.* 3rd Edition Abingdon: Routledge.

Modebelu, M. N.; Ogbonna, C. C. (2014) *Reform-Based-Instructional Method and Learning Styles on Students' Achievement and Retention in Mathematics: Administrative Implications.* International Journal of Education and Literacy Studies, v2 n2 p48-52 https://files.eric.ed.gov/fulltext/EJ1149626.pdf

Muijs D. & Reynolds D. (2000) *School Effectiveness and Teacher Effectiveness in Mathematics: Some Preliminary Findings from the Evaluation of the Mathematics Enhancement Programme (Primary), School Effectiveness and School Improvement,* 11:3, 273-303, DOI: 10.1076/0924-3453(200009)11:3;1-G;FT273

Murphy, M.M., Sullivan, M., Chaillou, A.L. and Ross, K. (2011). *Measuring up: What teachers know about mathematics.* Perspectives on Language and Literacy, 37(2), p.36.

National Mathematics Advisory Panel (NMAP) Reports of the Task Groups and Subcommittees (2008) *National Mathematics Advisory Panel. Chapter 6: Report of the Task Group on Instructional Practices.* US Dept of ED - https://files.eric.ed.gov/fulltext/ED502980.pdf

National Research Council (NRC) (2001). *Adding it up: Helping children learn mathematics.* J. Kilpatrick, J. Swafford, and B. Findell (Eds.). Mathematics Learning Study Committee, Center for Education, Division of Behavioral and Social Sciences and Education. Washington, DC: National Academy Press.

NCCA, (1999). *Primary School Curriculum: Mathematics.* Dublin: The Stationary Office.

NCCA, (2009). *Aistear The Early Childhood Curriculum Framework: Guidelines for Good Practice.* Dublin: NCCA

NCCA, (2018a) *Primary Mathematics Curriculum* NCCA: Dublin Available at: https://ncca.ie/media/3148/primary_mathematicsspec_en.pdf (Accessed 10 November 2021)

NCCA, (2018b) *Research Report No. 18 Mathematics in Early Childhood and Primary Education (3-8 years) Teaching and Learning.* NCCA: Dublin Available at: https://ncca.ie/media/2147/ncca_research_report_18.pdf (Accessed 25 November 2021)

NCCA, (2019) *Preparation for Teaching and Learning - Guidance for All Primary and Special Schools*. NCCA: Dublin. Available at: https://ncca.ie/media/5016/preparation-for-teaching-and-learning.pdf (Accessed July 3rd, 2022)

NCCA, (2020a) *Draft Primary Curriculum Framework Frequently Asked Questions (FAQs)* https://ncca.ie/media/4616/faq-document-primary-draft-framework.pdf (Accessed 10 November 2021)

NCCA (2020b) *Draft Primary Curriculum Framework for Consultation.* NCCA: Dublin. Available at: https://ncca.ie/media/4870/en-primary-curriculum-framework-dec-2020.pdf

NCCA (2022) *Primary Mathematics Curriculum Draft specification for consultation.* NCCA: Dublin. Available at: https://ncca.ie/media/5370/draft_primary_mathematics_curriculum_specification.pdf

OECD (2021) *Education at a Glance 2021: OECD Indicators.* OECD Publishing: Paris, https://doi.org/10.1787/b35a14e5-en (Accessed 23rd August 2022)

O'Shea, J., Leavy, A.M. (2013) Teaching mathematical problem-solving from an emergent constructivist perspective: the experiences of Irish primary teachers. *J Math Teacher Educ* **16,** 293–318. https://doi-org.jproxy.nuim.ie/10.1007/s10857-013-9235-6

Parks, A. & Chang Blom. D., (2014) *Helping Young Children See Math in Play.* Teaching Children Mathematics, *20*(5), 310–317. https://doi.org/10.5951/teacchilmath.20.5.0310

Pearson, P. D., & Gallagher, M. C. (1983). *The instruction of reading comprehension.* Contemporary Educational Psychology, 8(3), 317–344. https://doi.org/10.1016/0361-476X(83)90019-X

Piaget, J. (1962) *Play, Dreams, and Imitation in Childhood.* New York, NY: Norton Psychol. 5, 6–18. doi: 10.2753/RPO1061-040505036

Piaget, J. (1977). *The Development of Thought.* Equilibration of Cognitive Structures. Oxford: Basil Blackwell.

Piggot-Irvine, E., Rowe, W., & Ferkins, L. (2015) *Conceptualizing indicator domains for evaluating action research,* Educational Action Research, 23:4, 545-566, DOI: 10.1080/09650792.2015.1042984

Pianta, R. C., Barnett, W. S., Burchinal, M., and Thornburg, K. R. (2009). *The effects of preschool education: what we know, how public policy is or is not aligned with the evidence base, and what we need to know.* Psychol. Sci. Public Interest Suppl. 10, 49–88. doi: 10.1177/1529100610381908

Pithouse, K., Mitchell C & Weber S. (2009) *Self-study in teaching and teacher development: a call to action,* Educational Action Research, 17:1, 43-2, DOI: 10.1080/09650790802667444

Project, L.M. (2011) *Measuring the mathematical quality of instruction. Journal of Mathematics Teacher Education,* 14, 25-47. https://link-springer-com.may.idm.oclc.org/content/pdf/10.1007/s10857-010-9140-1.pdf

Pyle, A., & Danniels, E. (2017) *A Continuum of Play-Based Learning: The Role of the Teacher in Play-Based Pedagogy and the Fear of Hijacking Play.* Early Education and Development, 0(0), 1–16. http://doi.org/10.1080/10409289.2016.1220771

Rosenshine, B. (2008) *Five Meanings of Direct Instruction.* Academic Development Institute.

Rosenshine, B. (2010) *Principles of instruction;* Educational practices series; Vol.:21; 2010. The International Academy of Education, 21(2010).

Rosenshine, B. (2012) *Principles of Instruction: Research-Based Strategies That All Teachers Should Know.* American Educator, 36(1), p12-39.

Schoenfeld, A. H. (2004) *The Math Wars*, *Educational Policy*, 18(1), pp. 253–286. doi: 10.1177/0895904803260042.

Schön, D. A. (1987) *Education the reflective practitioner: Toward a new design for teaching and learning in the profession.* San Francisco: Jossey-Bass.

Shulman, L. S. (1986) *Those Who Understand: Knowledge Growth in Teaching.* Educational Researcher, 15(2), 4–14. https://doi.org/10.2307/1175860

Shulman, L. S. (1987) *Knowledge and Teaching: Foundations of the New Reform.* Harvard Educational Review, 57, 1-22. http://dx.doi.org/10.17763/haer.57.1.j463w79r56455411

Singer, D., Michnick, G. R., Hirsh-Pasek, K., & Singer, D. (2006). *Play = Learning: How play motivates and enhances children's cognitive and social-emotional growth.* Oxford University Press

Simon, M. A. (1995) *Reconstructing Mathematics Pedagogy from a Constructivist Perspective.* Journal for Research in Mathematics Education, 26(2), 114–145. https://doi.org/10.2307/749205

Skemp, R. R. (1978) *Relational understanding and instrumental understanding. The arithmetic teacher,* 26(3), 9-15.

Skott, J. (2008) *Contextualising the notion of 'belief enactment'.* J Math Teacher Educ 12, 27–46. https://doi.org/10.1007/s10857-008-9093-9

Solis, L., Ertel, K., Mardell, B., Fan, S., LeVangie, S., Maurer, G., and Scarpate M., (2021) *Empowering, meaningful, and joyful: Playful learning in six schools in the United States A Pedagogy of Play working paper.* http://www.pz.harvard.edu/sites/default/files/PoP%20USA%20indicators%20working%20paper_FINAL_25%20Jan%202021.pdf

Sullivan, B., Glenn, M., Roche, R. and McDonagh, C. (2016) *Introduction to Critical Reflection and Action Research for Teacher Researchers.* London: Routledge

Sullivan, P. (2011) *Teaching Mathematics: Using research-informed strategies.* Australian Council for Educational Research. Camberwell: Victoria. https://research.acer.edu.au/cgi/viewcontent.cgi?article=1022&context=aer

Sweller, J. (2011). *Cognitive load theory.* In J. P. Mestre & B. H. Ross (Eds.), The psychology of learning and motivation: Cognition in education (37–76). Elsevier Academic Press. https://doi.org/10.1016/B978-0-12-387691-1.00002-8

Tovey, H. (2017) *Bringing the Froebel Approach to your Early Years Practice.* 2nd Ed. London: David Fulton

UN (1989) *United Nations Convention on the Rights of the Child.* Geneva: United Nations Treaty Series, vol. 1577, p. 3,

UNICEF (2018) *Learning through play Strengthening learning through play in early childhood education programmes.* UNICEF: New York.

Vainio, A. (2013) *Beyond research ethics: anonymity as 'ontology', 'analysis' and 'independence'',* Qualitative Research, 13(6), pp. 685–698. doi: 10.1177/1468794112459669.

Van der Grift, W. (2007) *Quality of teaching in four European countries: a review of the literature and application of an assessment instrument*, Educational Research, 49:2, 127-152, DOI: 10.1080/00131880701369651

Van Oers, B., & Duijkers, D. (2013). *Teaching in a play-based curriculum: Theory, practice and evidence of developmental education for young children.* Journal of Curriculum Studies, 45, 511–534. doi:10.1080/ 00220272.2011.637182

Vanassche, E., & Kelchtermans, G. (2016). *Facilitating self-study of teacher education practices: toward a pedagogy of teacher educator professional development.* Professional Development in Education, 42, 100 - 122.

Vygotsky L.S. (1967) *Play and its role in the mental development of the child.* Journal of Russian and East European Psychology.

Vygotsky, L.S. (1978) *Mind in society: The development of higher psychological processes.* Cambridge, MA: Harvard University Press.

Walsh, G., Sproule, L., McGuinness, C., Trew, K., Rafferty, H. and Sheehy, N. (2006) *An appropriate curriculum for 4–5-year-old children in Northern Ireland: Comparing play-based and formal approaches.* Early Years: An International Journal of Research and Development, 26(2): 201–21

Weckler. A. (2022) Instagram poised to leapfrog Facebook as Ireland's number one social media network. *Independent.ie* [online] Available at: https://www.independent.ie/irish-news/news/instagram-poised-to-leapfrog-facebook-as-irelands-number-one-social-media-network-41212775.html (Accessed 5 September 2022)

Whitebread, D., Neale, D., Jensen, H., Liu, C., Solis, S.L., Hopkins, E., Hirsh-Pasek, K. Zosh, J. M. (2017). *The role of play in children's development: a review of the evidence (research summary)*. The LEGO Foundation, DK.

Whitehead, J. (2017) *Practice and Theory in Action Research: Living Theories as Frameworks for Action,* P. 387-401 in Rowell, L. L., Bruce, C., Shosh, J. M. & Riel, M. M. Palgrave International Handbook of Action Research, US; Palgrave Macmillan.

Whitehead, J. (1989) *Creating a living educational theory from questions of the kind, 'How do I improve my practice?* Cambridge Journal of Education, 19(1).

Wiles, R., Crow, G., Heath, S., & Charles, V. (2008) *The Management of Confidentiality and Anonymity in Social Research,* International Journal of Social Research Methodology, 11:5, 417-428, DOI: 10.1080/13645570701622231

Willingham, D. T. (2009) *Is it true that some people just can't do math?* American Educator, 33(4), 14-19.

Winter, R. (2002) *Truth or fiction: problems of validity and authenticity in narratives of action research,* Educational Action Research, 10:1, 143-154, DOI: 10.1080/09650790200200178

Zosh, J.M., Hassinger-Das, B., Toub, T.S., Hirsh-Pasek, K. & Golinkoff, R. (2016) *Playing with Mathematics: How Play Supports Learning and the Common Core State Standards.* Journal of Mathematics Education at Teachers College, Vol 7, no. 1. The LEGO Foundation: DK. https://doi.org/10.7916/jmetc.v7i1.787

Zosh, J. M., Hopkins, E. J., Jensen, H., Liu, C., Neale, D., Hirsh-Pasek, K., Solis, S. L., & Whitebread, D. (2017) *Learning through play: a review of the evidence (white paper).* The LEGO Foundation: DK.

Zosh, J. M., Hirsh-Pasek, K., Hopkins, E. J., Jensen, H., Liu, C., Neale, D., Solis, S. L., & Whitebread, D. (2018) *Accessing the Inaccessible: Redefining Play as a Spectrum*. Frontiers in psychology, *9*, 1124. https://doi.org/10.3389/fpsyg.2018.01124 Accessed: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6084083/

Zeichner, K., & Liston, D. (2010) Reflective Teaching: An Introduction. Mahwah, NJ: Routledge.

Appendices

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7.1 Appendix I - Parental Information Forms and Assent/Consent Forms.

Maynooth University
National University of Ireland Maynooth

Dear Parent(s)/Guardian(s),

I hope you are keeping well. Thank you for your continued support. This year I have chosen to return to education. I am currently studying to complete a Masters of Education in Maynooth University.

As part of my degree I am engaging in an action research project. I am exploring teaching maths in the senior primary classroom. The focus of the research is on my teaching of maths. I aim to investigate how I can teach maths to help build children's skills and confidence. The focus of the research is on using structured play and teacher modelling to enhance understanding of key mathematical concepts. This research will take place as part of our normal maths lessons.

I am hoping to ensure that children are challenged to complete tasks at their level while having fun. Play is a powerful way to learn and you may have heard from your child that we play a lot of learning games. I aim to research the impact play-based learning has on children's learning in maths.

I intend to carry out research in the classroom by developing games and activities to help children achieve the learning goals I have for them. Children will be involved in playing games, discussing their learning in maths and talking about what we can do to help them learn. My aim is to ensure that your children are receiving quality maths instruction to help them learn and that they enjoy taking part in maths lessons in the classroom.

The children's privacy is of paramount importance. All information will be anonymised and confidential. The child's name and the name of the school will not be included in the thesis that I will write at the end of the research. Your child can withdraw from the research process at any stage. Data will be collected through teacher observations, surveys, photographs and interviews. I will be keeping a journal of insights about my experiences in the classroom. The children will be asked to share their opinions on their attitude to maths, how they learn and their experience of play in the classroom.

All information will be confidential and information will be destroyed in a stated timeframe in accordance with the University guidelines. The research will not be carried out until approval is granted by the Froebel Department of Primary and Early Childhood Education.

I would like to invite you and your child to give permission for him/her to take part in this project.

If you have any queries on any part of this research project or would like further information feel free to contact me by email at michelle.hannafin.2022@mumail.ie

Kindest regards,

Michelle Hannafin

Maynooth University
National University of Ireland Maynooth

Information Sheet for Parents

I am undertaking an action research project as part of my Masters in Education. Below is some additional information that may be helpful. I have explained some the information to the children and would appreciate if you would talk to them about it also. You can decide whether to give consent to allow your child to take part. Your child can also decide whether or not to take part and can withdraw their assent at any stage. At all times, the wellbeing of your child will be of the utmost importance and all information gathered will be both anonymous and confidential.

What is this Action Research Project about?

Teachers undertaking the Master of Education in the Froebel Department of Primary and Early Childhood Education at Maynooth University, are required to conduct an action research project, examining an area of their own practice. This project will involve an analysis of the teacher's own practice. Data will be generated using observation, reflective notes and questionnaires. The teacher is then required to produce a thesis documenting this action research project.

What are the research questions?

- How can I teach maths using a balance of teacher led instruction and play based learning, underpinned by conceptual understanding, to ensure children are challenged and learn while having fun?
- What are the benefits of using play-based leaning in the senior classroom?

What sorts of methods will be used?

A number of methods will be used to help me gather the information I need. The methods I plan to use include; observation of the students in class, Note taking in a reflective journal, questionnaires, anonymous survey on google forms, interviews with students in small groups. Photographs of pupils engaged in activities and audio recordings may also be used. Children's consent will be asked before any photographs or audio recordings are taken. Children are welcome to fully take part in the research without consenting to photographs or audio recordings. Videos of children will not be taken. All data will be gathered in a sensitive and non-stressful manner.

Who else will be involved?

The study will be carried out by myself as part of the Master of Education course in the Froebel Department of Primary and Early Childhood Education. The thesis will be submitted for assessment to the module leader Dr Bernadette Wrynn and will be examined by the Department staff. The external examiners will also access the final thesis.

What are you being asked to do?

You are being asked for your consent to permit me to undertake this study with my class. In all cases the data that is collected will be treated with the utmost confidentiality and the analysis will be reported anonymously. The data captured will be used for the purpose of the research as part of the Master of Education in the Froebel Department, Maynooth University and will be destroyed in accordance with University guidelines.

Contact details:

Michelle Hannafin **Email: michelle.hannafin.2022@mumail.ie**

Hi everyone,

This year I have gone back to college to learn even more about teaching as I would like to be a really great teacher! This year I am working on how I teach maths. I would like to find out more about how I can teach maths in a way that is fun and that helps you to learn. I would like to watch you and listen to you in school and write down some notes. I will ask you to take part in some surveys and interview you about how you find learning maths. I'll be interested to hear your opinions. I will take some photographs of the activities we are doing. At the end of the research I'll be writing a book all about what I have learned about teaching maths. I will explain what we are doing as we go along.

Are you happy to take part? Circle one. YES NO

I have asked an adult at home to talk to you about this. If you have any questions, I would be happy to answer them. If you are happy with that could you sign the form that I have sent home? If you change your mind after we start, that's ok. You can talk also to me about the research at any stage.

Thank you,

Ms Hannafin

Maynooth University
National University of Ireland Maynooth

Parental/Guardian Consent Form

I have read the information provided in the attached letter and all of my questions have been answered. I voluntarily agree to the participation of my child in this study.

Parent / Guardian Signature: _____

Parent / Guardian Signature: _____

Date: _____

Name of Child: _____

Child's signature: _____

Date: _____

Maynooth University
National University of Ireland Maynooth

Child's Assent to Participate

My parent/guardian has read the information sheet with me and I agree to take part in this research.

Name of child (in block capitals): _____

Child's signature: _____

Date: _____

7.2 Appendix II - Letter to the Board of Management

Michelle Hannafin,
ADDRESS
ADDRESS

Dear Board of Management members,

As some of you are aware I have recently started a Master's in Education in Maynooth University. I wanted to make the board aware of the research as it will be taking place in the classroom setting.

The research is a self-study action research project where I investigate my own teaching and aim to improve my practice. I will be studying mathematics education in my classroom, with a focus on teacher instruction and using playful learning to enhance learning.

I will explain the research to the children in my class and ask for consent from parents and children for data to be collected in the classroom. The children will be viewed as co-collaborators who are valued and respected. Data will be collected through surveys, Google forms, conversations, and photographs of children's work. All data collected will be anonymised. Children's names and the name of the school will not be mentioned in the research as confidentiality and data protection procedures will be strictly followed.

All children are welcome to participate and can choose whether data will be collected from them. As the research will take part as part of our normal mathematics lessons the children will not be impacted in any way if they choose not to take part.

I hope to share the results of the research with my colleagues on the staff of (school name) to help our school develop in relation to teaching mathematics.

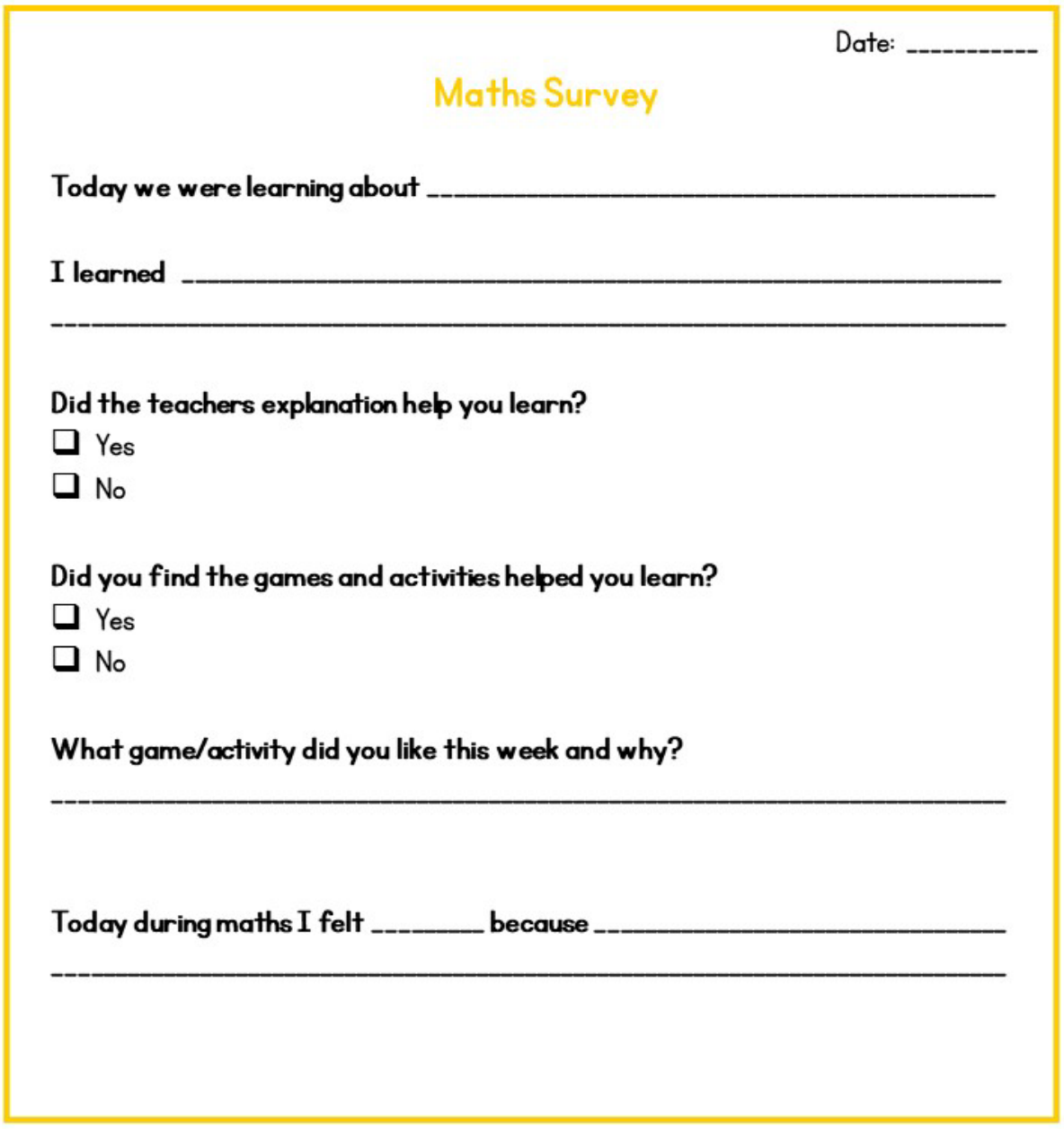
Thank you for taking the time to read my letter and feel free to contact me at (school email address) if you have any queries about the research.

Kindest regards,

Michelle Hannafin

7.3 Appendix III - Written Survey Templates

Written Survey 1:



Date: _____

Maths Survey

Today we were learning about _____

I learned _____

_____

Did the teachers explanation help you learn?

❑ Yes

❑ No

Did you find the games and activities helped you learn?

❑ Yes

❑ No

What game/activity did you like this week and why?

_____

Today during maths I felt _____ because _____

_____

Written Survey 2:

Date: _____

Maths Survey

Today we were learning about _____

Two things I learned this week are:

_____

_____

_____

Did the teachers explanation help you learn?

❑ Yes Why/Why not?

❑ No _____

_____

Did you find the games and activities helped you learn?

❑ Yes Why/Why not?

❑ No _____

_____

What game/activity did you like this week and why?

_____

_____

Today during maths I felt _____ because _____

_____

One thing I would like to learn more about is _____

_____

7.4 Appendix IV - Written Survey Results

Written Survey 1 Results:

Maths Survey Date: 01/04/2022

This week we were learning about _____

Length – 9/17 respondents
Length, Width and Perimeter 3/17 respondents
Length and Perimeter 2/17 respondents
Measuring 2/17 respondents

Did the teachers explanation help you learn?

❑ Yes 17/17 respondents Yes because before we got work she showed us on the board
❑ No 0/17 respondents

Did you find the game/activity helped you learn?

❑ Yes 17/17 respondents Because it was fun and interesting.
❑ No 0/17 respondents

What game/activity did you like this week and why?

- Bingo because it was fun and helped me learn
- Bingo because it great and nowing the new things 5.0 = 500.
- I liked measuring things around the room and maths bingo because they were interesting and fun.
- Are sheets I like the one were it goes 100cm 1m 0cm 10/10m 1.0m
- I liked maths bingo because its fun, helps you learn and competitive.
- I loved the bingo because it was fun and easy.
- Maths bingo it helped me to learn more things about length
- Bingo because its fun.
- I liked the bingo and measuring around the room because now I know how tall a metre is.
- I liked doing bingo because it was fun.
- Bingo! Because there will always be winner.
- I like bingo because we won rubbers and it was cool playing maths bingo.
- I loved the bingo because it was fun and helpful.
- Bingo. It helped the most.
- Bingo cause it's fun.
- Bingo x2

What game/activity did you like this week and why? (cont.) Date: 01/04/2022

Today during maths I felt _____ because _____

- Good because I was able to do the maths and it was fun.
- Good because I lurned how to understand how to like length.
- Happy because we played maths bingo and done some sheets.
- Happy because I love MATHS! and its cool and good.
- Great because it was fun and I understood everything very clearly
- Happy because we're not doing very difficult work and that was nice.
- Happy because I was having fun.
- Happy because I love length.
- Happy because maths is fun.
- Fine because I knew some stuff but I learned about the perimeter and other stuff!
- Happy because it wasn't boring.
- Happy because we play lots of fun games and I learn more about length.
- Happy because I learnt more about length.
- Good because it was really FUN!
- Good because it was fun
- Happy because I enjoyed it.

I learned _____

- about length and perimeter.
- what perimeter means
- a lot about maths I learned what the perimeter means and width.
- that the word perimeter means all the sides going around a shape
- that with perimeter you have to add all of the sides
- perimeter and measuring
- that 100cm is the same as 1m and about different stuff like width and perimeter.
- about metres and centimetres
- lines
- lots about length. we learned a new word called perimeter and teacher told us what it meant and it was fun.
- about length and how to measure things. measuring thing (cm) measuring people kg?
- That there are millimetres and metres.
- how to be very specific with measuring.
- about perimeter
- about length, fractions and decimals.
- more things
- about how to find the perimeter of shapes.
-

Written Survey 2 Results:

Date: 3/05/2022

Maths Survey

This week we were learning about _____

Fractions – 15/16 respondents
Fractions and tallest tower 1/16 respondents

Two things I learned this week are:

- Improper fractions. Mixed numbers
- Putting fractions on number lines and adding fractions
- How to add fractions
- We learned mixed fractions and we played a fraction game
- Mixed fractions writing the mixed fraction after counting how many fractions there were and the tallest tower wins.
- I learned that you can add a lot of different fractions to make a whole and I learned about improper fractions and mixed fractions.
- Tallest tower in town fractions.
- fractions
- Improper fractions and lots of other fractions I haven't learned before.
- I learned many new and interesting
- I learned about improper fractions and fractions on a numberline
- 2/8 = 1=4 lots of fractions are the same.
- Improper fractions and mixed fractions x2
- I learned fractions and thirds.
- Improper fractions. mixed numbers.

Date: 3/05/2022

Did the teachers explanation help you learn?

- ❑ Yes 16/16 respondents
- ❑ No 0/16 respondents

Why/Why not?

- Teacher helped me learn by explaining the questions very well.
- Yes because we played games to help us learn.
- Yes because it helped me understand.
- Yes because they explain it properly.
- I don't know.
- The explanations help because they told us what to do and how to do it.
- It helped me because I understood it better.
- because if you did not I would not know how
- Yes because it was easy to understand
- Teacher explained it really well.
- It helped me understand all the fractions and about mixed fractions.
- Yes it did because she explained the things very well.
- It was easy to understand.
- She showed us on the board.

Did you find the games and activities helped you learn?

- ❑ Yes 14/16 respondents
- ❑ No 2/16 respondents

- Tallest tower in town helped me to divide like 1/8 = (drew a circle divided into eights with one eight coloured in)
- They were fun games. I liked tallest tower in town.
- I didn't know about fractions but when we played a few games I knew.
- Yes because it helped me understand how fractions work.
- I think they helped me learn because they were fun and helpful.
- I understood it better.
- The games helped me learn because they were fun.
- They were fun and they helped me learn fractions.
- It helped me because it was a fun way of learning.
- They did, because it made learning fun for me.
- Yes because the games that we did were the same and easier and smaller
- I didn't find the games helped.
- No but they are very fun and I did like them.

Date: 3/05/2022

What game/activity did you like this week and why?

- I liked tallest tower in town because it was fun ☺
- The card game because it was fun.
- I liked tallest tower in town helped me learn and it was fun.
- I liked the tallest tower wins and the game with the square paper fraction where you flip the paper. I liked the game because it was fun!
- I liked the fraction card game because it helps you learn what fraction is bigger and its competitive.
- I liked tallest tower in
- I liked the tower game because it was a fun game.
- The bigger fraction
- I liked tallest tower in town because it was fun
- I liked tallest tower in town because it was really fun and it helps me learn my fractions better.
- Tallest tower in town.
- The tallest tower.
- I liked tallest tower in town because it was easy and also fun.
- The fraction game was fun because we got to see what fraction we got. And it helped me learn.
- Tallest tower in town it was fun.

Today during maths I felt _____ because _____

- Happy because I learned about mixed fractions.
- Great because I understood everything very clearly.
- Happy because I understood what the teacher was saying.
- Happy because I learned where the fractions are on the number line
- Okay because I knew how to do everything because teacher explained it good.
- Happy because I was learning.
- Happy because I was able to do them!
- Good because I knew how to do it.
- Good because it was fun and easy.
- Good because I understood.
- Happy because it was very fun maths today.
- Happy because we got to play a game and the worksheets weren't boring.
- Happy because I understood what teacher was saying.
- Happy because it was good.
- Happy because I was doing well with my work.

Date: 3/05/2022

One thing I would like to learn more about is _____

- I don't know x3
- Adding time
- Quarters
- Long multiplication
- Division probably
- Adding fractions.
- A mixst number
- Anything that involves drawing or art.
- The clock because I find it hard.
- Different types of ways fractions work like how to use them in a multiplication sum.

7.5 Appendix V - Interview Transcripts

Small Group Interviews 1,2,3 and 4 – Session One 29/04/2022

Schedule of questions to guide the conversation during the interviews:

1. How did you find maths this week?
2. What games/activities helped you to learn?
3. What did you learn from taking part in the game/activity?
4. Did taking part in games help you complete the worksheets (independent work)? Why/ Why not?

Small Group Interview 5,6,7, 8 and 9 – Session Two 11/5/22 and 12/5/22

Schedule of questions to guide the conversation during the interviews:

1. Do you think having a good teacher is important for learning in maths? Why?/ Why not?
2. What do good teachers do?
3. What helps you to learn in maths?
4. Do you think playing games is a good way to learn in maths? Why/ Why not?

The questions were used as a guide to lead conversation. As hearing authentic child voice was an aim I followed the children's lead in the conversation where possible while still using the questions to guide the discussion as relevant.

Session Two Interviews – 29th April 2022

Small Group Interview 1: 29/4/22

Length of recording: 4:54

Participants: Child 11, Child 13, Child 19

Group context: The three children in this conversation are high achievers in mathematics. In June 2022 their standardised test results range from the 94% - 99% percentile.

Teacher:	Is there anything you would like to tell me about how maths went this week?
Child 11	I really enjoyed doing the games.
Child 13	The games were really fun.
Child 19	Yeah. Tallest tower in town was great.
Teacher:	This one?
11,13,19	Yeah.
Teacher:	So what I'm doing is I'm trying to show other teachers and talk about for me what works in maths. So you think this game worked?
11,19	Yes
13	Yeah it was really good.
Teacher:	Can you tell me why it worked?
Child 11:	Because it was like we weren't doing maths and it was just playing a game.
Teacher:	It was just playing a game. But do you think you learned anything from playing this type of game?
Child 11:	Yeah
Child 13:	How different fractions can make a whole. That was one thing I learned.
Child 19:	Yeah.
Child 13:	Say its 4/8 I could also use a completely different type of fraction like a half
Child 11:	Yeah
Teacher:	Yeah. Okay. Very good. Thank you. So, you were learning like how different fractions added together.
Child 11:	Oh yes
Teacher:	Yes. Anything else it helped you learn?
Child 11:	That learning maths through games is awesome.
Teacher:	That's good.
Child 19:	Yeah, it's really fun.
Teacher:	You enjoy it? It makes it a bit more fun? So what I was hoping this game would do was introduce mixed numbers to us. Did it do that?
Child 13:	Oh yeah.
Child 11:	Definitely
Child 13:	It definitely helped.
Teacher:	It definitely helped? And did it help you start to learn about adding mixed numbers as well?
Child 19:	Yeah.
Child 11:	Oh yes yes.
Teacher:	Why do you say yes?

Child 11: Because we were adding them together in the little boxes.
Child 19: Yeah
Teacher: Could you give me an example?
Child 11: 3 and half and 0 and 2/3 would not be able to, we couldn't add that one together. Definitely not.
Teacher: You couldn't add that one. You'd have to do something else. But I get you. You were starting to think about them adding together.
Child 19: If we had like 4/8 and a half and then 3. We put in the 3 and put in another one for 4.
Child 13: Or a half and 1 and during the next spin you have a chance of getting 2/4 which is also equal to ½
Teacher: Okay so my main feedback is that it was fun
Child 19 Yes
Child 11 Yes definitely
Teacher: And that it helped us learn.
Child 13 Yeah
Child 11 Yes
Teacher: Would you like to play similar games again?
Child 19 Yes
Child 11 Absolutely.
Teacher: Absolutely. Okay great. Let me see. We did a few other things this week as well. I just brought out these sheets so I could remember. Yesterday we did comparing fractions and we did this game here. How did you find this game here?
Child 11 Pretty easy
Child 13 Competitive
Teacher Pretty easy, competitive,
All: Yes
Child 19 It was really fun though as well.
Teacher: It was fun, but it was easy? How could I make this one more challenging?
Child 11: By using bigger fractions I guess?
Child 19: Like maybe 1 and 1/8,
Child 13 Mixed fractions
Child 11: Oh yeah! Mixed fractions and improper fractions.
Child 19: Yeah
Teacher: So next week could we play a similar game?
Child 19: Yeah
Teacher: Would that make it a bit more challenging?
Child 11: Absolutely.
Teacher: Absolutely. Okay. So we might try a very similar game, the biggest fraction or the smallest fraction but make it maybe with some mixed fractions, or bigger fractions to try.
Child 13: It would make people think more about the numbers they have and then whoever gets it will make them think more about it.
Teacher: And did you have to do a lot of thinking in maths this week?
Child 11: Yeah.
Child 13,19 Yeah

Child 11: But it wasn't boring.
Teacher. But it wasn't boring? Why was it not boring?
Child 11: Because we were playing games and that's fun.
Child 19: Yeah
Child 13: And games aren't stressful they are just fun to play.
Child 11: Yep
Teacher: And do you ever feel stressed in maths?
Child 13 Not really.
Child 11 Nope.
Child 19 Not really.
Teacher: Not really. That's good. What makes you feel not stressed?
The games that we play
Yeah
Teacher And how were the worksheets and activities we did afterwards?
Child 13 Pretty easy.
Child 19 Yes
Child 11 Yeah they weren't actually that hard.
Teacher: They weren't that hard. Do you think having played the games made it easier to do the worksheets?
Child 19: Yeah
Child 11 Yeah I think so.
Teacher: You think so?
Child 13: Games were one thing that helped explain.
Teacher: Yeah? They helped explain what we were doing? Em.. One of the other things I am also looking at is me and how I am teaching. So do you think I help you learn as well?
Child 19: Yeah
Child 11: Absolutely
Child 13. Yes definitely
Teacher: Can you think of an example of anything this week that you thought oh that was helpful teacher.
Child 11: Em.. doing all the games.
Child 19: Em… When we were doing tallest tower in town and then we done the worksheet where you had to write in the fraction. It was easier then because you knew what fractions like to write in.
Child 13: You were also explaining how to play the games.
11,19 Yeah
Teacher: Yeah? That was helpful?
Child 13 Yes. Definitely.
Teacher: Okay. Is there anything else you would like to say about maths this week?
Child 13: It was fun.
Child 11: Fun
Child 19: Fun
Teacher: Final note: it was fun. Thank you for having a conversation with me. Would you be okay if we had another conversation next week or the week after?
Child 1 Sure!
Okay great! thank you for your help. I'm going to send you back and get some more lovely helpers.

Child 19 Okay!
Child 13 Yeay.
Teacher: Thank you very much.

Small Group Interview 2: 29/4/22

Length of recording: 4:42

Participants: Child 2, Child 3, Child 4

Group context: This group had children with mixed ability. Two of the children find mathematics quite challenging and often look for support in maths. The other child is very capable but can be distracted at times.

Teacher: What I called you out here to chat about was how you found maths this week.
Child 4: Em.. kind of hard. A tiny bit.
Child 3: Kind of… In between hard and easy.
Child 2: Yeah
Teacher: Okay. That's great. Maths should be a little bit challenging, shouldn't it? If it was really easy that wouldn't be good. But we don't want it so challenging that it's really stressful either.
Child 3: Yeah
Teacher: You say it was kind of hard. What was kind of hard?
Child 4: Em... bigger sums…
Child 3: Mixed numbers as well
Teacher: Using mixed numbers was a bit tricky?
Child 2: I felt that plusing some of the fractions was kind of hard.
Child 3: Yeah
Teacher: That was kind of hard? Can you think of any activity we did this week that you found kind of tricky?
Child 4: The tower at first.
Teacher: The tower at first? So, the game we were playing? I have a picture here. So, we were playing the tallest tower activity and it was hard at first. Why do you say it was hard at first?
Child 2: Cos I didn't really know what to do.
Child 3: Yeah
Teacher: Okay
Child 2: That was kind of hard. I didn't know what to do.
Child 4: Yeah
Teacher: And what happened then?
Child 4: Then the next day Child 3 knew somehow. Laughs. And then told me.
Teacher: Do you remember we did a bit of work on these squares? Did that help?
Child 4: Yeah.

Child 2: I thought that was kind of easy.
Teacher: That was easy enough?
Child 3,4: Yeah
Teacher: Did that make the game a little bit easier? Because we had some practice turning the squares into the quarters and halves?
Child 2: Yeah
Child 3 Um hmm.
Teacher: I thought that too. The first day we played it as a whole class I thought 'Oh wow everyone found it pretty tricky.' But you definitely felt it was easier the second day?
Child 3,4: Yeah
Child 4: Way easier.
Teacher: Way easier the second day? Is there any reason it was easier the second day?
Child 3: Hmmm…
Child 4: I dunno
Child 2: We done it the first day?
Teacher You had done it the first day. So you had practice doing it. Yeah maybe that's why
Child 3: Yeah.
Teacher: And did you enjoy this game?
Child 2: Yeah
Child 3: Yep
Child 4: It was fun.
Teacher: It was fun?
Child 3: Very fun
Teacher: Very fun. Great. Do you think it helped you learn about mixed numbers?
Child 3,4 Yeah
Teacher How did it help?
Child 2: It kind of helped cos at first I didn't really get it but then when I got it, it kind of helped with the mixed numbers.
Child 3: Yeah
Teacher: Okay. Great. Was there any other activity we did this week that you found useful?
Child 4: Em ... Yeah. That game.
This one? Why was this one helpful?
Child 3: It showed us all the fractions that we can use.
Child 4: Yeah.
Child 2: And which ones can be bigger and which ones are smaller.
Child 3: Yeah.
Bigger and smaller. And do you think it was better to play a game or do a worksheet on that?
Child 2: A game.
Child 3: Game.
Teacher: Why was the game better?
Child 4: I don't know. Games are fun.
Child 2: Yeah they're funner and easier.
Child 3: So I think doing games would make it easier to do the sheet. Then when you do the game you understand the sheet.

Child 4: Yeah

Child 2 It's easier to do like say the game.. do the game first and then you give us a sheet.

Teacher: You find that helpful, did you? We kind of did that today, a little bit. What were we doing today? Fraction lines? How did you find the lines?

Child 4: Okay.

Child 2: I found the lines quite easy.

Child 3: Good. Yeah.

Teacher: Was there anything in particular that helped you understand them?

Child 4: The board.

Child 3: Yeah.

Teacher: The board? When I was showing them on the board?

Child 4: Yeah

Teacher: Why did that help?

Child 4: I don't know

Teacher: You could just see what was happening? It helped it make sense.

Child 2: When you gave us like the sheet to do by ourselves, I found that easier than what we were doing on the whiteboard.

Child 3: Yeah.

Teacher: Yeah.

Child 4: The less than and the greater than I found that good.

Teacher: That was good as well? What we were doing yesterday?

Child 4: Yeah.

Teacher: So that's great. So overall how would you rate your maths this week? What was your general feeling about it?

Child 4: An A

Teacher: An A? You're going to give it an A? You're feeling was good. Is there anything you would like me to improve on next week?

Child 4: Hmmmm.

Teacher You're not sure? Okay. What did you like Child 2? How was your general feeling about maths this week?
Probably a 7 or and 8 out of ten.
Yeah, mine was an 8 out of ten.
Okay

Child 2: It was kind of fun all the stuff we did.

Child 3: Yeah
So it was pretty fun? But maybe a bit hard at times.

Child 4: Yeah.

Child 2: The hardest thing was the survey. I didn't really know what to write.
Yeah

Teach It's hard knowing what to write isn't it, but that's okay. That's why I said I'd actually get us out for a chat because then I might understand better what you want to say because it's hard to write it down sometimes, we don't know what to write. But do you feel positive about maths this week?

Child Yeah

Teacher: Do you feel it was a bit of a challenge?

Child 3,4: Yeah

Teacher: Did you enjoy the games?
Child 4: Yeah.
Child 3: Very much.
Teacher: Okay. Child 3 did you want to give us a number out of ten before we finish up?
Child 3: 8
Teacher: The same 8 out of ten, okay! We'll take that. That's great. Guys, thank you so much for coming for a chat. You can head back in and I'll get a few more people for a chat.

Small Group Interview 3:

29/4/22

Length of recording: 5:10

Participants: Child 5, Child 6, Child 10, Child 14

Group context: This is a mixed ability group of children.

Teacher: What I wanted to have a quick chat about was how you found maths this week.
Child 10: It was good.
Child 5: Interesting
Child 14: It was fun and easy
Child 5: Interesting.
Teacher: Child 5 says interesting, Child 14 says fun and easy.
Child 10: Yeah. It was okay. It was kind of fun I guess.
Teacher: Right Child 10, we'll take that.
Child 6: The games were fun and the actual maths part was easy.
Child 10: Yep
Teacher: Okay so do you think the games helped the maths be easy?
Child 5 Yeah
Child 6: Yes
Child 14: Yes
Teacher: Yeah? What games did you like this week?
Child 5: I liked the tallest tower.
Child 6: Tallest tower.
Child 10: Tallest tower in town.
Teacher Great we are all saying that one. Why did you like this game?
Child 10: Because it was just like… fun
Child 14: It was great for adding fractions.
Child 5: It was relaxing.
Child 14: It was fun for adding fractions and helped adding fractions.

Child 6: Yeah like adding fractions.
Teacher: It helped adding fractions and it fun. It was easy.
Child 10: Um hmm.
Teacher: And were you able to add fractions before this?
Child 10: Emm.. not as good.
Child 6: No.
Child 5: Not at all.
Child 6: I was never able to add fractions at all.
Chid 14: I was but not as good.
Teacher: You were but not as good?
Child 14: It took me a long time. It would have taken me like five minutes to do them adding fractions.
Teacher: And I know, I think this game was a bit hard the first time we played it, was it?
Child 10: Em…
Child 5: Not hard
Child 14: It wasn't hard, it was easy.
Child 10: I'd say it was like middle of the road.
Child 6: In the middle
Teacher: In the middle of the road. Okay. So, it was in the middle. What made it better the second day?
Child 10: Em…. We done a big debate… We understood it.
Child 14: We actually understand how to do it.
Child 5: We understood it.
Child 10: We understood it and it was easier.
Teacher: Yeah, and we did a bit of work, didn't we on these guys. Did that help?
Child 10: Yeah.
Child 6: Yeah, kind of.
Teacher: Maybe? Kind of?
Child 6 Maybe a little bit.
Child 5: It was okay.
Teacher: Would you say this game would help other people learn about fractions?
Child 14: Yes
Teacher: So, you think I should show it to other people, like Teacher B, would it help their class too?
Child 10: Yeah. Like if next year you were teaching another 4^{th} class, claps hands, use that.
Teacher: Use this one again? Its good? That means it helps you learn?
Children: Yeah
Teacher: Yeah? Okay. Was there anything else you felt helped you learn this week?
Child 14 The number lines helped and like adding fractions.
Child 10: Yeah, that was…
Teacher: Yeah? These guys today, the number lines? What was good about them?
Child 14: They kind of helped adding fractions if I wanted to get to a different number.
Teacher: How did you find doing them Child 10?
Child 10: It was okay. No real strong feelings
Teacher: What about you Child 6?
Child 6: It was in the middle.
Teacher: In the middle? Was it tricky at all? Or was it easy?

Child 6: Easy
Child 10: At first like the first couple of questions were easy
Child 6 Some of them were harder than others
Child 14: Yeah
Child 5: For me it was a bit confusing at first.
Teacher: Was there anything that made it easier?
Child 10: The more times you done it.
Child 5: You would understand it even more. You got the hang of it.
Child 6: Yeah, the first ones were easy.
Child 10 The more we done it the harder it got but also the better we got at it. So.
Teacher: You were able for the challenge? So, you like that we started easy and got a little bit harder as we went along?
Child 5: Yeah
Child 10: Yeah, that was the only reason it was easier.
Teacher: It was easier because you understood it?
Child 6: Yeah
Teacher: And if I'm looking at how well I'm teaching do you think I'm doing a good job?
Child 5: Yes.
Child 6: Definitely.
Child 10: Yeah.
Child 14: Definitely.
Teacher: Right why is it I'm doing a good job?
Child 14: The explanations are good.
Child 10: Because you don't get mad at someone if they get something wrong
Teacher: Nope. I generally try not to get mad.
Child 6: Oh my Mam used to get slapped across the hand with a ruler if she got something wrong.
Child 10: Everyone did. Every single one.
Teacher: Okay. Well I'm not sure that's a reason I'm good, anything else Child 14?
Child 14: Well your explanations really helped because em, sometimes people don't really know except like when someone says it and you just like put more details into it. That makes it even easier than it already was. You just splash details onto our sheets and our heads.
Teacher: Splash details?
Child 14: Yes
Child 10: I don't know why it's just that you're a good teacher and like you try and make the games like if we are doing anything you try and make up a fun twist to it.
Child 6: You make maths fun.
Teacher: Make maths fun? Do you think that is important?
Child 5: Yes
Child 14: Yeah
Teacher Do you think every teacher makes maths fun?
Child 10: Emmm… No
Child 6: Teacher C did.
Child 5: Every single lesson.
Teacher: Do you think it's helpful to your learning if it's fun?
Child 5: Yes
Child 14: Yeah

Child 10: Yeah because it encourages like
Child 5: If a couple of teachers do more it would be better.
Teacher: Yeah. So you think we should keep doing games?
Child 5: It helps you understand.
Child 10: It encourages.
Child 6: It helps me to understand.
Teacher: So when you are playing a game its helpful to understand?
Child 6: Yeah.
Teacher: Okay. Guys thanks for having a chat with me. Maybe we we'll have another chat again? Another week? Yeah. See you in five minutes. Slán.

Small Group Interview 4:

29/4/22

Length of recording: 4:54

Participants: Child 1, Child 7, Child 9, Child 15

Group context: This is a mixed ability group of children.

Teacher: How did you find maths this week?
Child 7: It was grand.
Teacher: It was grand?
Child 7: Yeah.
Child 17: Fine
Child 1: Pretty easy
Child 15: Fine.
Teacher: Right okay. What was good or not good about it. Give me one thing before the classes start coming out.
Child 7: Oh I forgot about that game.
Teacher: What was good or not good?
Child 15: I liked tallest tower in town.
Child 1: Me too. It's a good game.
Teacher: You liked tallest tower in town? Why?
Child 15: Because it's fun.
Child 7: I liked the way we could like just put the two fractions together and make the tower out of it. That was good.
Teacher: Do you think that helped your learning at all?
Child 1: Yeah
Child 7: Yeah. It helped me. See the way it's like one and 4/8. Eh. So that helped me.
Teacher: That kind of helped you understand? Yeah. When we were splitting and mixing. What do you think Child 9?
Child 9: I think it was also

Teacher: Was it a bit hard? I think a few people found it challenging the first time. What do you think

Child 15: It was a bit hard because I didn't understand and it was hard to teach Ira when I didn't understand.

Very short conversation as we were interrupted in the hallway as breaktime started.

Session Two Interviews – 11th and 12th May 2022

Small Group Interview 5 - 11/5/22

Length of recording: 4:44

Participants: Child 5, Child 17.

Group context: This is a mixed ability group of children.

Conversation context: I prepared a number of questions to ask the children, specifically about the role of the teacher and playful learning in the classroom.

Teacher: My first question is do you think having a good teacher is important for maths?

Child 17: Yes

Child 5: Yes

Teacher: Why do you think it's a good idea?

Child 5: Um… because they help you learn and you eh... helps you understand it more.

Teacher: Okay. Anything else? Thanks Child 5

Child 17: They give you great examples and help you when you are stuck so you know what to do the next time.

Teacher: And do you think if you had like a teacher or if the teacher said just said 'right you do it yourselves', would that be helpful?

Child 5: No

Child 17: It wouldn't really be helpful. I would like an example and then I would just do it.

Teacher So you find it easier when the teacher explains?

Child 5: Yes

Child 17: Yeah. Like if it's something new then I would like some explanations or examples.

Teacher: That makes sense. And… so you say you need a good teacher. Well what do good teachers do? Can you think in the classroom what things would you say a good teacher does?
Child 5: Well they… let their class play like games in maths and subjects.
Child 17: Most of the time we play games.
Teacher: We play a lot of games.
Child 17: Yeah.
Teacher: And you think that's the sign of a good teacher?
Child 17: Yes
Teacher: Why?
Child 17: Because a bad teacher would, would probably hand you the work, let you do it and once you're done, they would correct it. They wouldn't give you any examples or play games so it would be very just boring and hard.
Teacher: Boring and hard? So you would just have to sit there, do the work, correct the work and that's it. So what you've said to me is that good teachers give explanations and play games. Would you agree with that?
Child 17: Yes and they help.
Teacher: They help? How do they help?
Chile 17: They tell you how to do the questions and they… they sometimes they tell you to multiply something. Like Ms. A was helping Child 5 and she was telling him to multiply this and that and if he got it wrong she was like 'No do that again… its this and that'
Teacher: Okay so tell me what happens when something goes wrong. What does a good teacher do?
Child 17: They would tell you or they would correct it and tell you to try and work on that.
Teacher: Okay. Have you anything to add to that Child 5?
Child 5: Yeah. Maybe they would say 'oh that's not right but maybe you could try that again and I'll help you this time.'
Teacher: Okay. So if you have a good teacher teaching you how do you feel during maths class?
Child 5: Happy.
Teacher: Happy? Any other feelings?
Child 17: I feel like its getting easier.
Teacher: Its getting easier.
Child 17: And I also feel like I'm enjoying it.
Teacher You feel like you are enjoying it? Do you think that's important?
Child 5: Yes
Teacher: Should you enjoy school?
Child 5: Yes
Child 17: Yes. If you don't enjoy school then you wouldn't want to go so then you would make excuses and then you wouldn't learn so you probably wouldn't get a proper job.
Teacher: So it all leads from being in school and having fun. Okay. So the last thing I wanted to ask is do you think playing games is a good way to learn in maths?
Child 5: Definitely.
Child 17: Yes because everyone pays attention and it's fun.
Teacher: It's fun? And do you think doing things that are fun are important?

Child 17: Yes or else everyone will not want to go to school. They'll wake up and be like 'I don't want to go to school, it'll be boring,' instead of 'Oh yeay its time for school.'
Teacher: So is that what you say in the morning?
Child 17: To be honest I don't even think. I just get up, brush my teeth and eat.
Teacher: Yeah that's what I thought. So maths is overall enjoyable for you.
Child 5: Yes.
Child 17: Yes.
Teacher: Yeah. And what I'm looking into, I'm researching how important it is to have a good teacher and what the teacher does. So I'm looking into what I'm doing and seeing am I doing a good job. I'm also looking into the games and activities we are doing and saying are they good? Is that a good way for children to learn? So are you feeling that it's going well?
Child 5: Yeah.
Teacher: Would you agree that they are two important things for you learning maths in the classroom?
Child 5: Definitely
Teacher: Is there anything else that you think are important for learning maths in the classroom as well as games and having a good teacher?
Child 17: An example.
Teacher: Doing examples?
Child 5: Em. Help.
Teacher Teacher helping you when you are stuck. Is that what you mean by that?
Child 5: Yes.
Child 17 For kids not to shout out.
Teacher: People not to shout out? We don't normally do that do we?
Child 17: Yeah. No.
Teacher: Okay. Great. Thank you Child 17. Thank you child 5.

Small Group Interview 6 - 11/5/22

Length of recording: 4:43

Participants: Child 9, Child 10, Child 11,

Group context: This is a mixed ability group of children.

Conversation context: I prepared a number of questions to ask the children, specifically about the role of the teacher and playful learning in the classroom.

Teacher: My first question is do you think having a good teacher is important for learning in maths?

Child 10: Yes
Child 11: Definitely
Child 10: Yes
Teacher: Okay so you are saying yes and definitely. That's great. Why do you need a good teacher for maths?
Child 10: To encourage you.
Teacher: To encourage you. Child 11?
Child 11: Because if you have em a teacher who you don't like then you don't feel like you want to listen.
Teacher: Okay. Right
Child 9: I would agree with Child 10.
Teacher: You agree with Child 10? To encourage you? That's what he said.
Okay so you think it is important to have a good teacher. Well then the main question is what is a good teacher?
Child 11: Emmm…
Teacher: Can you think for a second and tell me what do good teachers do? What evidence is there that someone is a good teacher.
Child 10: They're nice. They're friendly. Em.
Child 11: A positive attitude.
Child 10: Yeah.
Teacher: Great. Nice, friendly, a positive attitude. Anything else?
Child 9: Kind
Teacher: Being kind. Can you think of an example child 9, in the classroom of a teacher being kind? What might that look like?
Child 9: I'm not sure
Teacher: Take a second to think about it.
Child 10 Maybe…
Teacher: If you think being kind is important. How would you see that in the classroom?
Child 10: A teacher helping a student that's stuck.
Teacher: Is that something you would see in our classroom?
Child 9: Yeah.
Teacher: Okay. So what else makes a good teacher? Being kind and being positive is important. Is there anything else that happens in our classroom that you think that's good teaching. That's good.
Child 10: We have good teachers.
Child 11: Definitely.
Teacher: Okay. So what do we do that's good?
Child 10: Its hard to describe it.
Teacher: I know it is. That's why I'm asking to have a conversation because its hard to describe it. So when you think of what we do in class, what things do we do that are helpful for you?
Child 11: Well the games definitely.
Child 10: Yeah the games.
Teacher: The games are helpful? How are they helpful?
Child 10: They help us understand.
Child 11: Because it doesn't feel like boring learning. It doesn't even… It feels like we are actually having fun through learning.
Teacher: But you are actually learning?

Child 11: Yeah.
Child 10: It's weird. How… it confuses me.
Teacher Yeah. But you like playing games in class?
Child 9: Yeah
Child 10: Absolutely.
Child 9: The multiplication one helps me em think about the multiplications quicker.
Teacher: Yeah? When you are doing your sums? Did you find it easier today after playing the game?
Child 10: Yeah.
Teacher Yeah? It was a good way to practice and do our tables.
Child 9: Yeah.
Teacher: Great. And so what makes maths fun or good or enjoyable?
Child 10: Understanding it.
Teacher: When you understand it.
Child 9: Its easier when you understand it.
Teacher What helps you understand it?
Child 10: The games and things like that help me kind of understand a bit more.
Teacher: We were doing long multiplication today. It wasn't as say, active. Was there anything that helped your understanding today?
Child 10: No. Oh flip I just realised something.
Teacher: What?
Child 10: When Child 9 said she agrees with me she said my name on the yoke.
Teacher: That's okay. I take them out afterwards. You'll notice I'm using your names because we use our names when we are talking When I record it and write it down I'll take them out.
Child 10: Wait will that be in the recording what I just said then?
Teacher: Yep. Its recording everything we are saying now. It's three minutes in. See the little line working. That's it recording us.
Child 11 Oh yeah.
Teacher: That's it recording us. I'll listen back later to see what we said.
Child 10: So if we all go quiet it won't hear any spikes in.
Child 11: Right?
All - Everyone stays quiet and watches the phone.

Child 11: Oooooooh
All Laughs
Child 10: Wow.
Teacher Okay. All right? Laughs. Now let's do my last few questions. Do you think playing games helps you learn?
Child 11: It does definitely.
Child 9: Yes.
Child 10: Yeah. It's the best thing.
Teacher: It's the best thing? And do think we do lots of them?
Child 10: Yeah
Child 9: Yes
Teacher: Is there anything else in school that you feel is good, that's helpful for you to learn.
Child 11: Ummm.
Child 10: The games. There's the teachers, kinda helps.

Child 9: The teacher helps
Child 11: Yeah and the games. Definitely the games.
Child 10: The games and the teachers help.
Teacher: Okay.
Child 10: If you have a good teacher it helps. It helps
Child 9: Yeah.
Child 11: A good teacher makes a big difference.
Teacher: Lovely. A good teacher makes a big difference. I agree. I think that's important. And do you think you have good teachers this year?
Child 10: Yeah
Child 11: Absolutely.

Small Group Interview 7 - 12/5/22

Length of recording: 5:02

Participants: Child 7, Child 8, Child 16,

Group context: This is a mixed ability group of children.

Conversation context: I prepared a number of questions to ask the children, specifically about the role of the teacher and playful learning in the classroom.

Teacher: We'll leave that down there. It will just record away happily. Okay. So. My first question is do you think it is important to have a good teacher for maths.
Child 8: Yes
Child 16: Yeah
Teacher: Do you think it makes a big difference?
Child 8: Yeah.
Teacher: Right why?
Child 8: Because like if they're strict you might want to like… you are not comfortable with them teaching maths.
Teacher: Okay. You are saying if they are strict, you might not be comfortable?
Child 8: Yeah.
Teacher: Okay. So you think you would be comfortable with a good teacher?
Child 8: Yeah and like you would probably be scared to get a question wrong cos they would like give out to you.
Teacher: Okay. So you think it's important to be able to make mistakes?
Child 8: Well like… you learn from your mistakes.
Teacher: Yeah. Okay, I agree, you do definitely learn from your mistakes. Any other thoughts.

Child 16. Giggles.

Child 7: Em. Eh Yeah. Well like it's important to have a good teacher because like if like. You have to have a good teacher if you want to learn maths because maths is a very important thing about life. Well you will use it a lot when you are older and now if you were going to work in a shop at the till or maybe wanted to be a scientist or maybe like you might calculate how to get somewhere, how long it would be. So that's... without going to school and learning maths you wouldn't be able to do that.

Teacher: You'd find it all very hard. There're some really good examples of…

Child 7: It's important. It's important to learn maths.

Teacher: You think it's important to have a good teacher. So, what does a good teacher do? Think of a classroom, our classroom, what does good teaching look like if you saw it in a classroom.

Child 8: They would explain it very well em and they would always make sure everyone is comfortable and like, like they are getting on okay with the work.

Child 16: They might would probably give them help when they were stuck. If you didn't have a good teacher, they probably wouldn't

Teacher: They probably wouldn't?

Child 16: Laughs

Teacher: Okay, Fair enough Anything else child 8?

Child 8: I agree with both of them.

Teacher: You agree with both of them? So you think good teaching is important.

Child 8: Umm hmm.

Teacher: And what type of activities do you think help make maths good for you? Or enjoyable or challenging?

Child 8: I think the games are good.

Child 7: And then like because it helps us like remember better, kind of.

Teacher: Okay. Can you think of any game you enjoyed doing?

Child 8: Monkey

Child 7: Yeah that was a good one. And I think the one we do inside in our classroom with the marker. That's good.

Child 8: For the tables

Teacher: The multiplication wheels one? Where you are going around in a big circle? Why is that helpful?

Child 7: Well… because… instead of the teacher saying to you 'what's 7x4?' And, but like.. If you are going up to them you are doing different ones every time kind of so you are not getting the same one kind of.

Teacher: Okay, very good, you are getting to practice lots of different ones. So games work to make maths good for you. How do you generally feel during maths class?

Child 7: Sometimes like they are challenging but sometimes they are not.

Teacher Okay. Sometimes things are challenging and sometimes there are not. Any other feelings you might feel in class?

Child 8: I think… I'm not sure.

Teacher: You're not sure? (pause..) Okay.
And… we do a lot of playing games. Do you think playing games is a useful way to learn in maths?

All: Yeah.

Teacher: Any reason why playing games is good for learning?
Child 7: Well its fun.
Child 8: Em.. It like.. sometimes it helps like… get it into our minds better. Because like.. we don't even realise that we are working. We just are playing the game.
Teacher: You're playing, yeah. And it's just like going in. You're having fun.
Child 8: Yeah.
Teacher You don't realise you're working as hard as you are. Yeah.
Child 16: Yeah.
Teacher: I know, I agree. If we did 100 sums in a game you wouldn't feel them but if we put a 100 sums on the board would we feel it?
Child 8: Yeah, no!
Teacher: We wouldn't feel it there either?
Child 8: And it's really fun when we play maths playground because there's loads of different types of games.
Teacher: Yeah? We must play a few more of those.
Child 8: I play that at home.
Teacher: Great! So is there anything else you would like to say about how you are learning maths or how you are finding maths.
Child: Ummmm… NO…
Teacher: No? Okay. We're happy? That's the end of our little conversation. I'm going to send you back and get someone else.

Small Group Interview 8 - 12/5/22

Length of recording: 4:29

Participants: Child 15, Child 2, Child 12, Child 13

Group context: This is a mixed ability group of children.

Conversation context: I prepared a number of questions to ask the children, specifically about the role of the teacher and playful learning in the classroom.

I'm going to record it. And my first question is do you think it is important to have a good teacher when you are learning maths?
All: Yes!
Child 13: Yes definitely.
Teacher: You think yes?
Child 13: Yes, cos good teachers will explain. Bad teachers will just leave you like that.. hoping that you know.
Child 15: Bad teachers will say 'do your work' and not explain it.
Teacher: You think it is important that things are explained.
Child13: Yeah.
Child 2: Otherwise you might have to explain it to yourself and like it might not be right.

Teacher: It might not be right? You think maybe having a teacher helping you is a good thing?
All: Yeah
Teacher: Do you think its possible to learn maths on your own?
Child 13: No…
Child 15: I think its possible… it would just be tricky.
Child 12: You could…
Child 2: It just might be hard
Child 13: Like if you didn't know what to do you might have to ask someone and then you could figure it out.
Child 2: Its good to know like… that if you are stuck you can ask for help.
Child 13: Its better be sure.. and its worse to be like guessing.
Teacher: Yeah? You would rather know what you were doing? Okay so you think it is important to have a good teacher. What does a good teacher do? If you think of a classroom… what would a good teacher be doing?
Child 13: Explaining stuff that you don't know.
Child 15: Playing games
Teacher: Playing games?
Child 13: Help you with your work.
Teacher: Help you. Okay. Very good.
Child 13: Emmm… We are all out of ideas apparently.
Teacher: Yeah. Okay. Child 15 you mentioned that playing games was good?
Child 15: Yeah. Cos games are fun!
Teacher: They're fun? So you think games are a good way to learn in maths.
Child 12: Well.. games are kind of fun and they kind of like.. you get to learn a lot of stuff.
Teacher: Yeah. Have you found like… we have done a lot of games over the last few weeks in maths. Do you find using games to learn helpful?
All: Yes/ Yeah.
Child 13: Yes definitely.
Teacher: Why? What does using games in maths do for you?
Child 12: It kind of explains it a bit more... through actual learning.
Child 13: It makes the maths funner and then we'll just want to do maths. Instead of just 'no I don't want to do it'.
Child 12: And it makes it fun like child 13 says.
Child 13: It will motivate us to do maths.
Child 2: I think if we play games first it kind of helps me understand what we are actually doing.
Child 12: Then it king of… we kind of get better at maths
Teacher: You get better at it? Child 2 it makes it easier for you to understand if we are doing a game or activity?
Child 2: Yeah
Teacher: Yeah? Is it easier? Do you find doing games easier than say doing a written activity in your copy?
Child 2: Em.. games are easier but it depends what we are doing cos normally the written work is easy.
Child 15: Teacher. I like the game where you have to run up and write in, like you're in a team, write in the multiplication, then if you don't do that and we are like doing

tables champs we wont really oh like what's the answer. With that one you need to know it first before you go up.

Teacher: Yeah you have to be prepared don't you? You are really thinking ahead. Yeah.

Child 2: I find tables champs fun and like it's quite helpful.

Teacher: We haven't done tables champs in a while. We must do it…

Child 13: I hate tables champs.

Teacher: You don't like the pressure?

Child 15: Child 13 just doesn't like tables champs because she always wins!

Child 13: No, I hate it.

Teacher: You don't like it?

Child 13: Eh, no.

Teacher: Okay. Alright.

Child 12: You always win though!

Teacher: The thing about games is they don't suit everyone. So you think playing games is a good idea in maths?

All: Yeah.

Teacher: Yeah, You mentioned it motivates us, makes it easier to understand.

All: Yeah.

Teacher: Is there anything else that helps you learn in maths?

Child 13: Teachers' explanation.

Child 2: Like when you write a few examples on the board and we do it on the whiteboards and you like see if we are doing it right. I find that helps me learn.

Teacher: Yeah so when we are practicing on our mini whiteboards. Yeah. Very good. And we mentioned explaining it. Very good.

Child 15: Sometimes if you ask people a question, they just like tell you the answer, but you actually like.. cos if… like you are not here for a minute and there's another one like that we won't know how to do it if you just tell us it but if you actually tell us how to do it then we can do the rest of it by ourselves.

Teacher: So you find it helpful if I explain what to do?

Child 15: Yeah.

Teacher: Yeah? Okay Great. So is there anything else you would like to tell me about how found maths over the last few weeks?

Child 12: Good!

Teacher Laughs. Just generally good?

Child 12: Yeah.

Teacher: Yeah?

Teacher: What about when we are in class, what feelings are you feeling during maths? Any feelings that come to mind?

Child 13: I feel good because I know you are going to explain everything and it will be much easier.

Child 15: I feel concentrated.

Teacher: You feel like you are concentrating? Even though we are doing loads of games.

Child 15: Yeah. Most of the time I am concentrating!

Teacher Most of the time you are concentrating.

Child 2: Yeah

Teacher: Yeah. You agree? Okay. Thank you guys so much for our conversation. It has been lovely. I am going to send you back now.

Small Group Interview 9 - 12/5/22

Length of recording: 6:01

Participants: Child 6, Child 14, Child 1, Child 4, Child 3

Group context: This is a mixed ability group of children.

Conversation context: I prepared a number of questions to ask the children, specifically about the role of the teacher and playful learning in the classroom.

Teacher:	I'm going to press record and ask you a few questions. Okay. So. My first question is do you think it is important to have a good teacher for maths?
All:	Yes
Teacher:	You are all saying yes. Is there any reason why?
Child 14:	Good teachers actually don't bail out and tell you the kids to just do the work themselves. This is what a bad teacher would do (American accent) "Okay kids just stay there, do your work, I'm going to grab a cup of coffee."
Teacher	Laughs… Right. Okay.
Child 14:	I'm great at accents.
Teacher:	Okay. Anything else?
Child 6:	It's good to have a good teacher em.. because… maybe to help you if you find some maths hard.
Teacher:	Okay. So you think it's important to have a good teacher? What do good teachers do in the classroom?
Child 1:	Em.. They help you a lot.
	They help you a lot? By doing what?
Child 3:	Explain the questions… that's what Child 14 says.
Teacher:	Alright. Okay. Guys anything else?
Child 4:	They could explain the answer really well.. so if you found something hard they could explain it and then you could be good at it.
Teacher:	That might make life easier. Okay. Anything else that good teachers do Child 1?
Child 1:	I was thinking that as well?
Teacher:	You were thinking that as well? So good teachers explain things. Is there anything else good teachers do in the classroom?
Child 6:	Ask the children if they know everything.
Teacher:	So check in to see if everyone understands things? Yeah? Is there anything that happens in our classroom that you think is good?
Child 3:	Em… The games.
Child 4:	Yeah! Playing the games
Child 6:	Oh yeah.
Child 1:	They help you learn
Child 14:	Yeah the games.
Teacher:	The games? You all like the maths games?
All:	Yeah.
Teacher:	So what makes games good for learning?
Child 6:	It turns learning maths fun.
Child 1:	Yeah.

Child 6: And like it helps you.
Teacher: It's fun and it helps? How does it help?
Child 6: If you don't get something, if you play it a few times you might get the hang of it, like the actual maths.
Teacher: Yeah? So you get lots of chances to practice it? It gets easier as you practice it.
Child 14: Yeah
Child 6: We think games are good.
Child 3: They are fun.
Teacher: Games are fun?
Child 4: Yeah. And they help us to learn.
Child 3: Yeah they are way better than worksheets.
Teacher: Way better than worksheets? Why are games way better than worksheets?
Child 6: Cos they're fun
Teacher: Do you think learning should be fun?
Child 4: Yeah.
Child 3: Kind of.
Child 6: Kind of?
Child 4: Like not like fully fun but fun enough.
Child 14: Yeah
Child 6: If you do a bit of work then you can play games.
Teacher: If you think of what we do in class do you think we have a good balance going on?
All: Yeah/ Yes
Teacher: Yeah? What do we have a balance of? What do we do? We mentioned games.. Games and…?
Child 6: Worksheets and stuff like that
Child 4: Working in our copies.
Teacher: Working in our copies. We do a mixture of things. Do you think that's a good approach to teaching maths?
All: Yeah/ Yes
Teacher: Do you think its helping you learn?
All: Yeah
Teacher: Is there anything you feel you have learned recently?
Child 14: What?
Teacher: Anything you feel you have learned in maths?
Child 6: I've gotten better at long multiplication.
Child 3: Yeah!
Child 14: Yeah long multiplication!
Child 4: Yes….
Child 14: The first time I did that I was like…. What the hell?
Child 3: Oh yeah.
Child 1 And I've learned division.
Teacher: Division? Do we need to do some work on division next week?
Child 3: Yeah.
Teacher: I think so. I think we do.
Child 4: I'm so bad at division.
Teacher: You're so bad at division? Well do you think we could try and play games to try and help that? Maybe? We might have to be creative.

7.6 Appendix VI - End of Intervention Survey

End of Intervention Survey - Schedule of Questions:

1. Choose one word to fill the blank. I am _____at maths.
2. Maths class this year is mostly _____.
3. Do you feel you learned a lot in maths this year?
4. What helps you learn in maths? (Tick any options that you feel help you. You can choose more than one answer.)
5. During maths I feel. (You can choose more than one answer.)
6. Do you think playing games helps you learn in maths class?
7. I think games in maths are…
8. When I am playing games I feel ….
9. What games did you enjoy playing?
10. Did you enjoy maths this year?
11. Do you think the teacher explaining helps you learn in maths
12. Do you think it is important to listen to the teacher in maths? Why?
13. When I am listening to the teacher explaining in maths I mostly feel...
14. Do you feel more confident in maths after the work we have done in the last few weeks?
15. Do you feel happier in maths class this year?
16. Can you think of a time you felt stressed/ anxious in maths? What made you feel this way?
17. How would you describe my teaching in maths?
18. Is there anything else you would like to tell me about your experience of maths this year?

7.7 Appendix VII – Instagram Survey

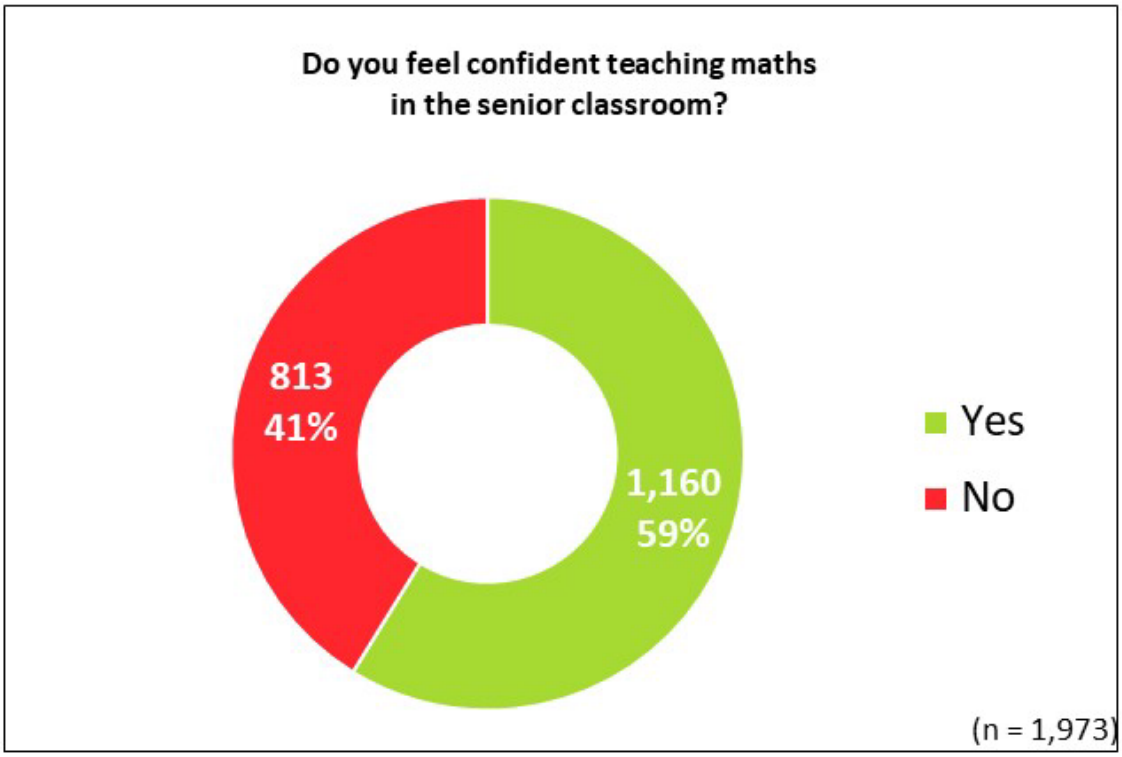
Instagram survey:

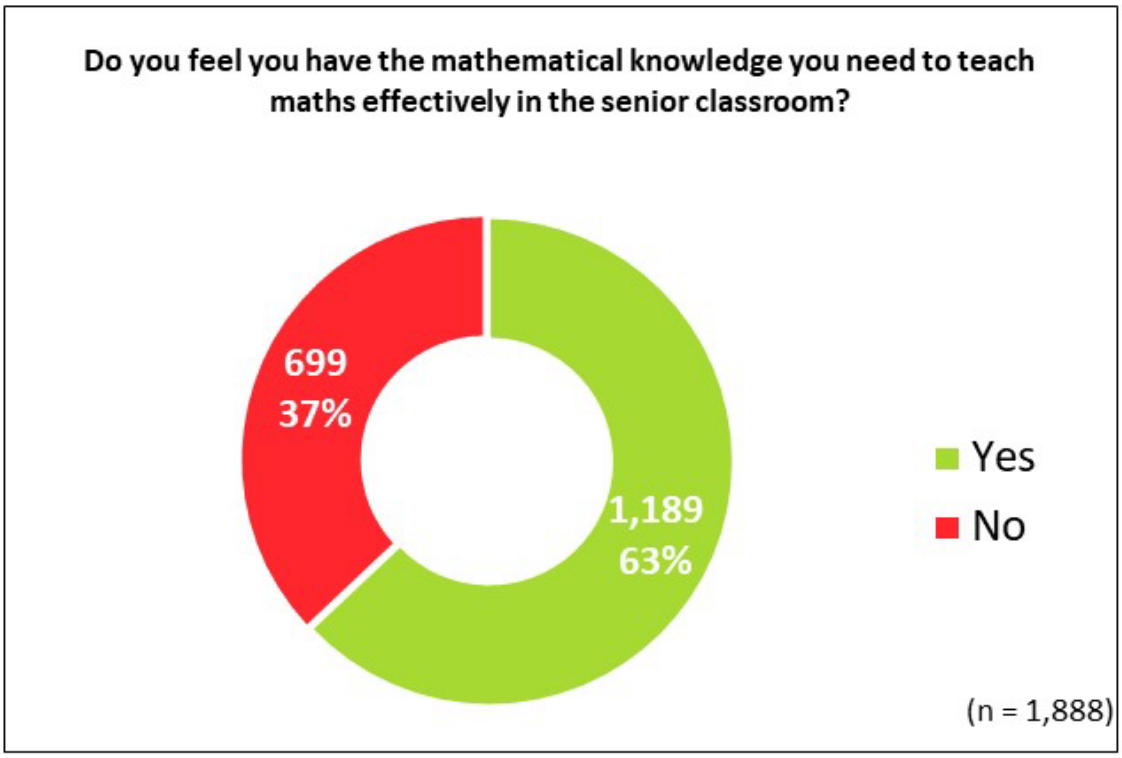
The survey was carried out on Instagram from 17:00 May 19th – 17:00 May 20th, 2022, and was used to gather the perspectives of teachers in Ireland on teaching maths in the senior classroom. It was shared on my Instagram page 'Michelle's Innovative Ideas' using the stories feature. Teachers who follow my Instagram page had the option to complete the survey if they choose to and no incentives were offered to complete the survey. All the data gathered was anonymous and voluntarily given. Using an Instagram survey afforded a large number of teachers the option to take part in the survey. Teachers had a 24-hour period to answer the questions and each person could only complete the survey once. Teachers were not able to view the results or the responses of others. Once the time period for the survey had elapsed teachers were no longer able to view it. After the 24-hour period the data was saved in my Instagram archive where it can be accessed be me and I downloaded a record of the survey using screenshots. The data was then transcribed in Microsoft Word and Microsoft Excel to create graphs using the information.

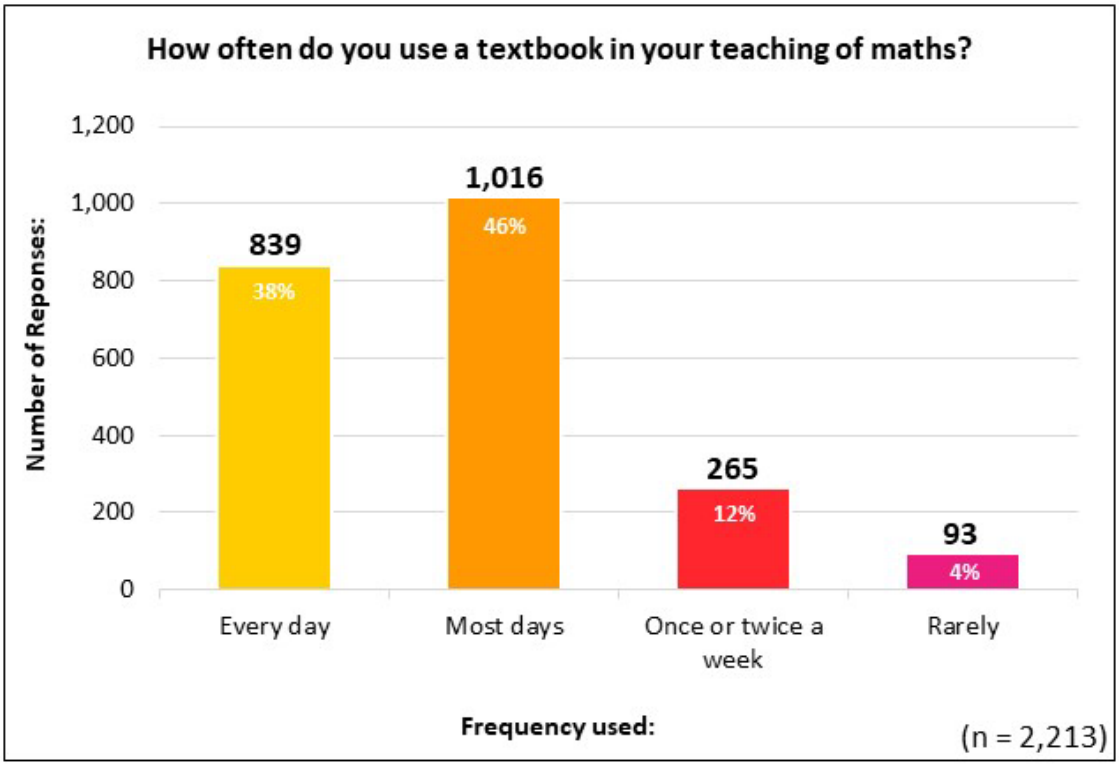
This appendix contains the schedule of questions, graphs showing the data from the multiple-choice questions and the written responses to the short answer questions which were colour coded during the data analysis process to identify emerging codes and themes.

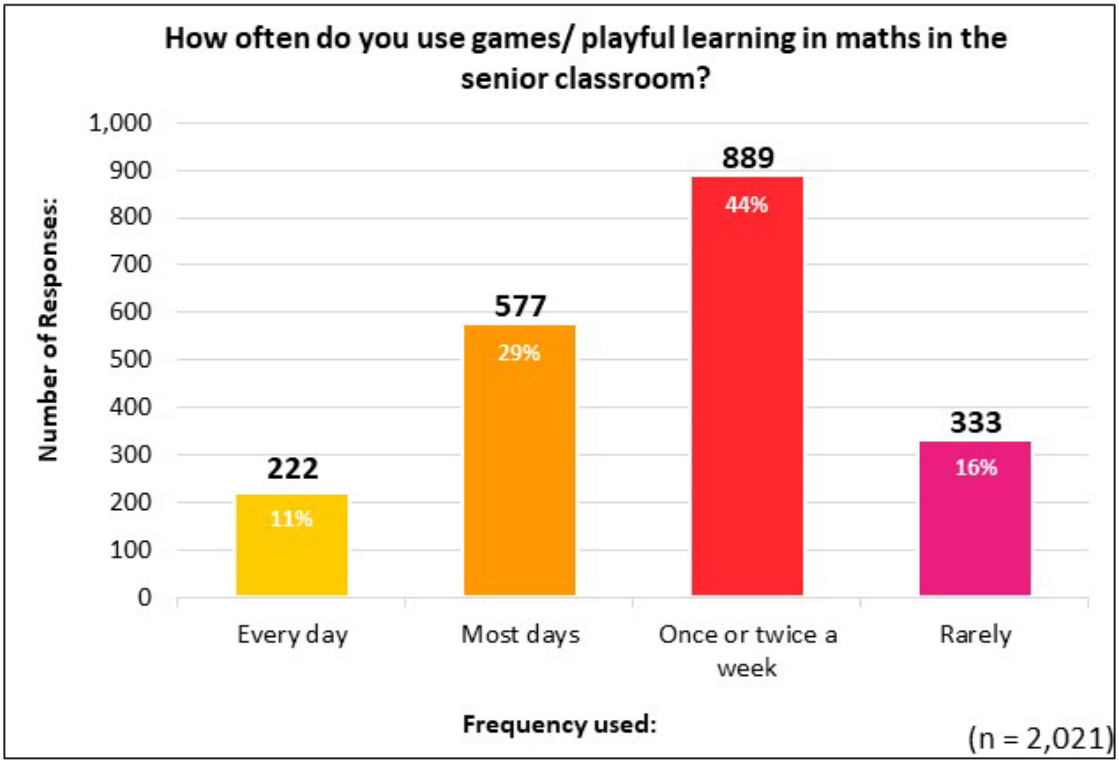
Instagram Survey - Schedule of Questions:

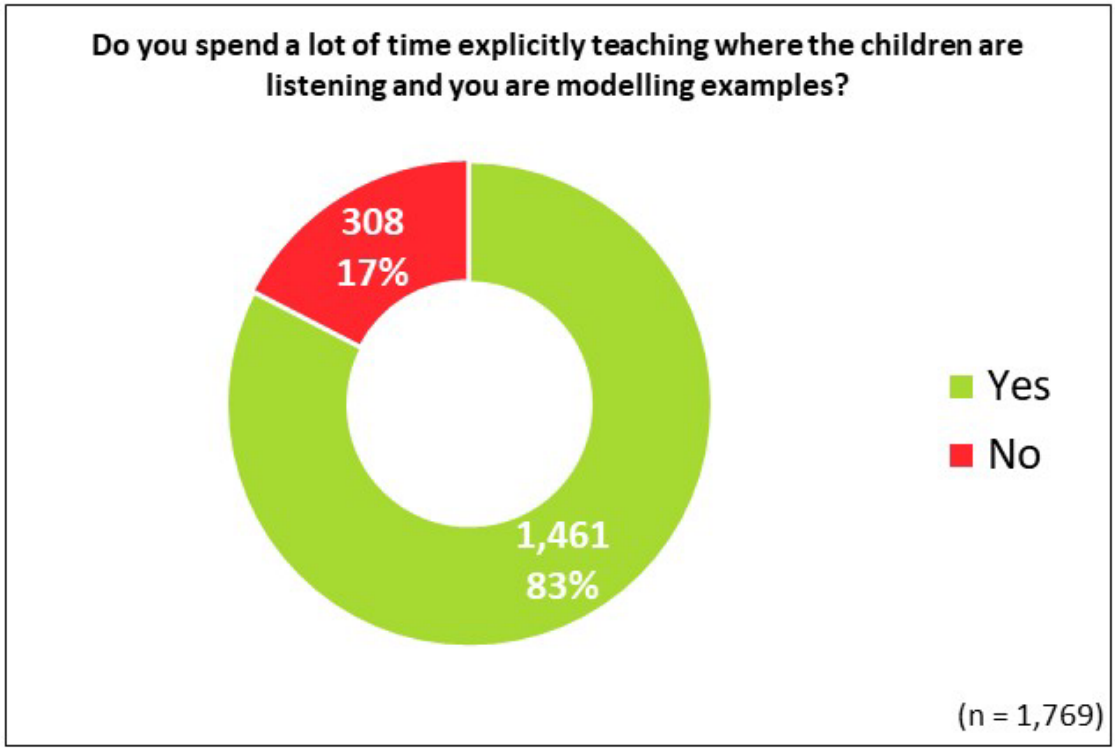
	Question:	Question Format:	Number of Responses:
1.	Do you feel confident teaching maths in the senior classroom?	Multiple Choice	1,973
2.	Do you feel you have the mathematical knowledge you need to teach maths effectively in the senior classroom?	Multiple Choice	1,888
3.	How often do you use a textbook in your teaching of maths?	Multiple Choice	2,213
4.	How often do you use games/ playful learning in maths in the senior classroom?	Multiple Choice	2,021
5.	Do you spend a lot of time explicitly teaching where the children are listening and you are modelling examples?	Multiple Choice	1,769
6.	How important do you think the role of the teacher is in providing quality maths education?	Multiple Choice	1,868
7.	Would teaching maths ever put you off taking a senior class?	Multiple Choice	1,964
8.	Did your teacher training provide you with adequate skills to teach maths in a senior classroom?	Multiple Choice	1,927
9.	What does effective maths teaching look like?	Written Response	193
10.	What do you find most difficult about teaching maths in a senior class?	Written Response	244
11.	Do you think the maths book is an effective tool to teach maths in the senior class?	Multiple Choice	1,523
12.	How often do you have active learning in maths in the senior classroom? (For example: using concrete materials, group work, mini whiteboard activities etc.)	Multiple Choice	1,434
13.	Do you enjoy teaching maths?	Multiple Choice	18,18

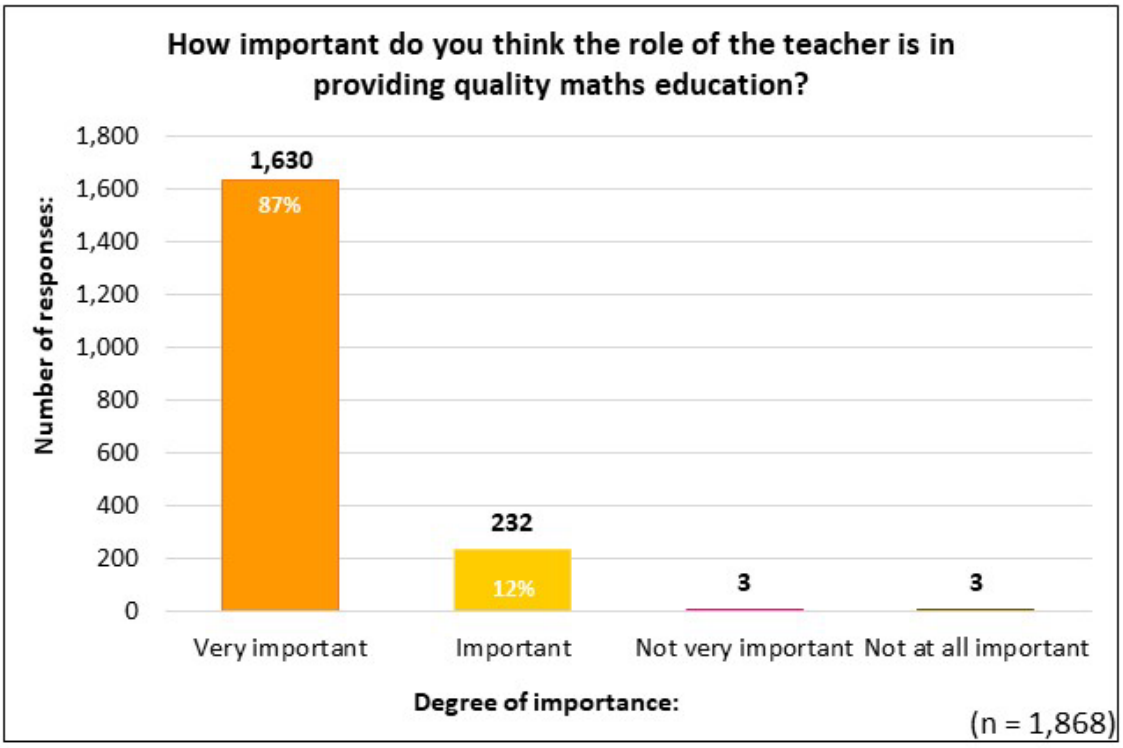

Do you feel confident teaching maths in the senior classroom?
813
41%
1,160
59%
Yes
No
(n = 1,973)

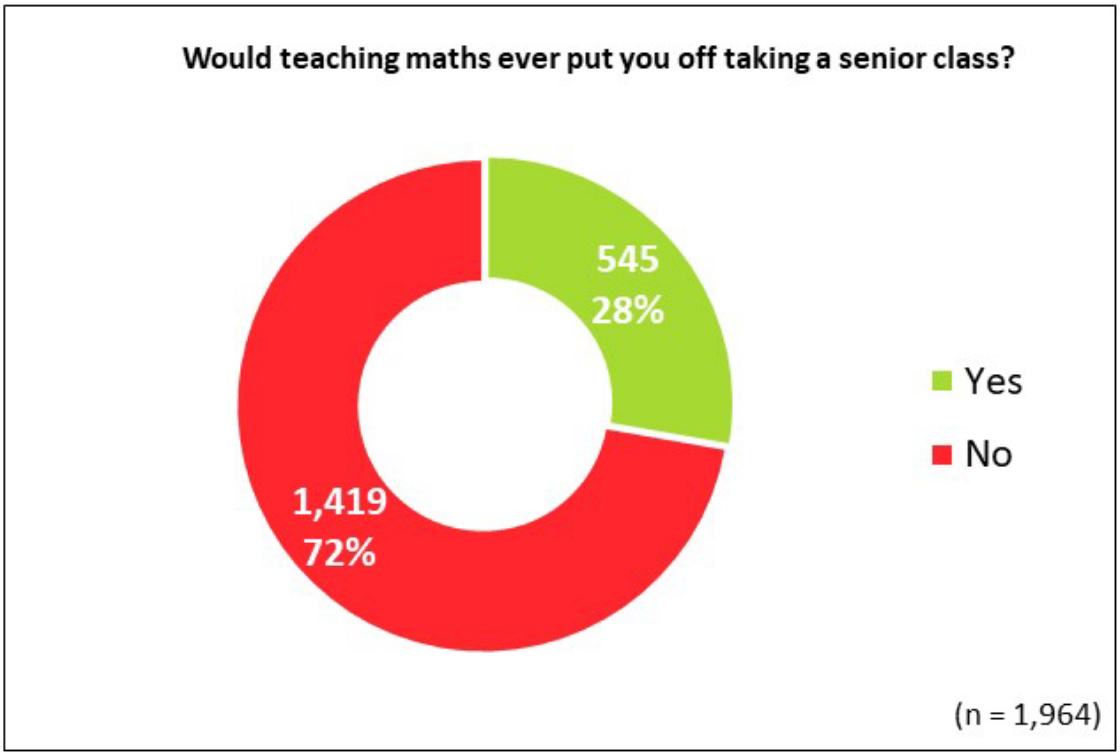

Do you feel you have the mathematical knowledge you need to teach maths effectively in the senior classroom?
699
37%
1,189
63%
Yes
No
(n = 1,888)

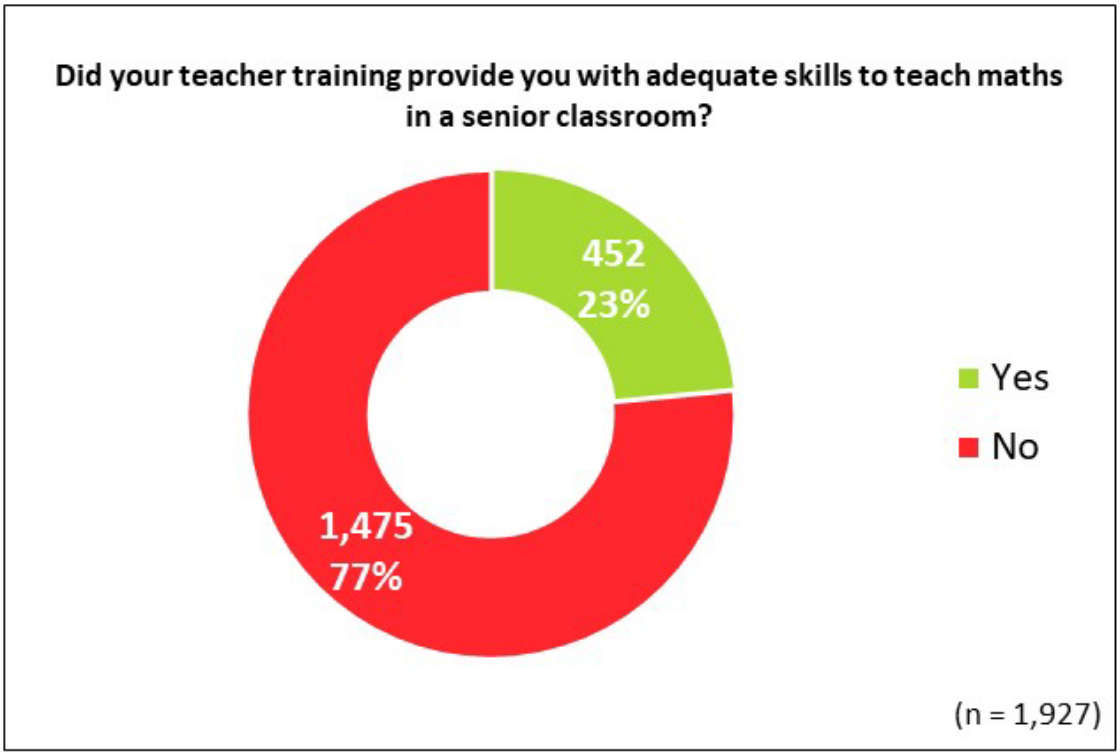

How often do you use a textbook in your teaching of maths?
Number of Reponses:
1,200
1,000
800
600
400
200
0
839
38%
1,016
46%
265
12%
93
4%
Every day
Most days
Once or twice a week
Rarely
Frequency used:
(n = 2,213)

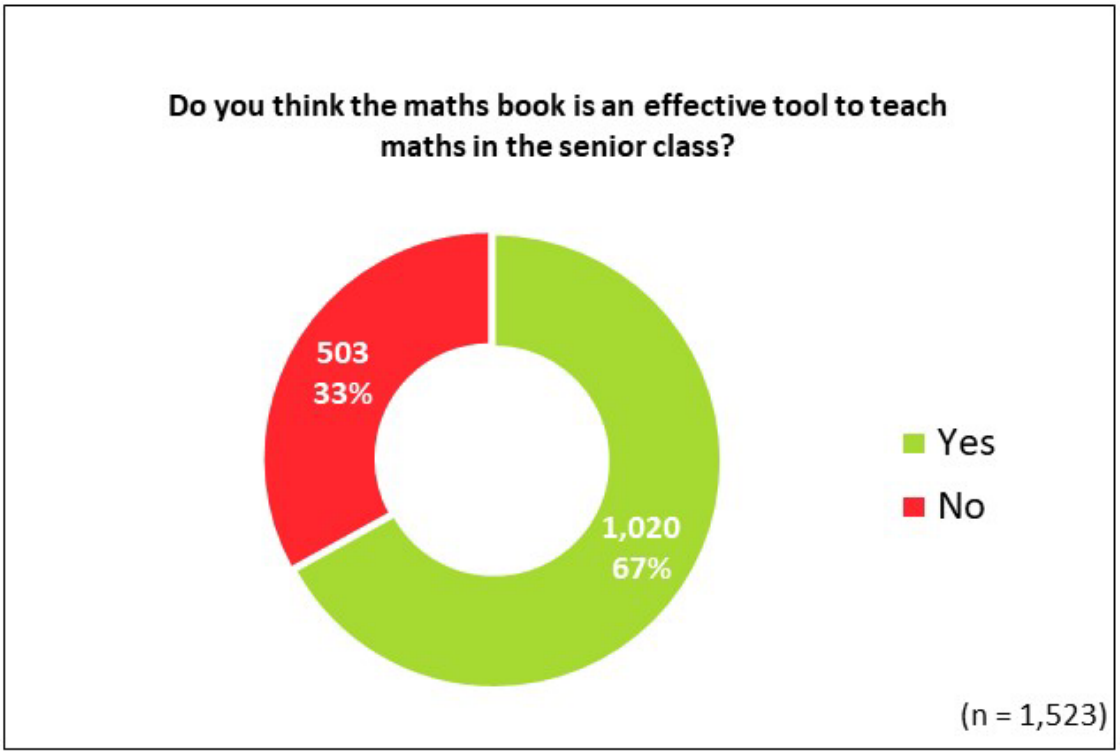

How often do you use games/ playful learning in maths in the senior classroom?
Number of Responses:
1,000
900
800
700
600
500
400
300
200
100
0
222
11%
577
29%
889
44%
333
16%
Every day
Most days
Once or twice a week
Rarely
Frequency used:
(n = 2,021)

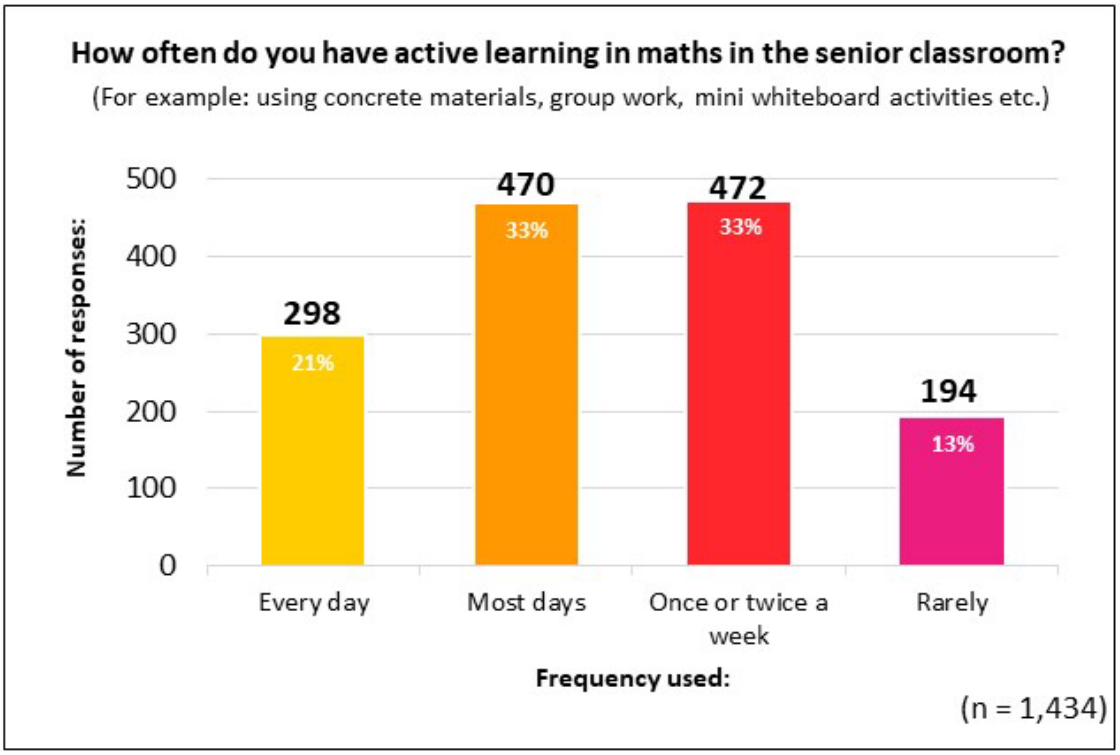

Do you spend a lot of time explicitly teaching where the children are listening and you are modelling examples?
308
17%
1,461
83%
Yes
No
(n = 1,769)

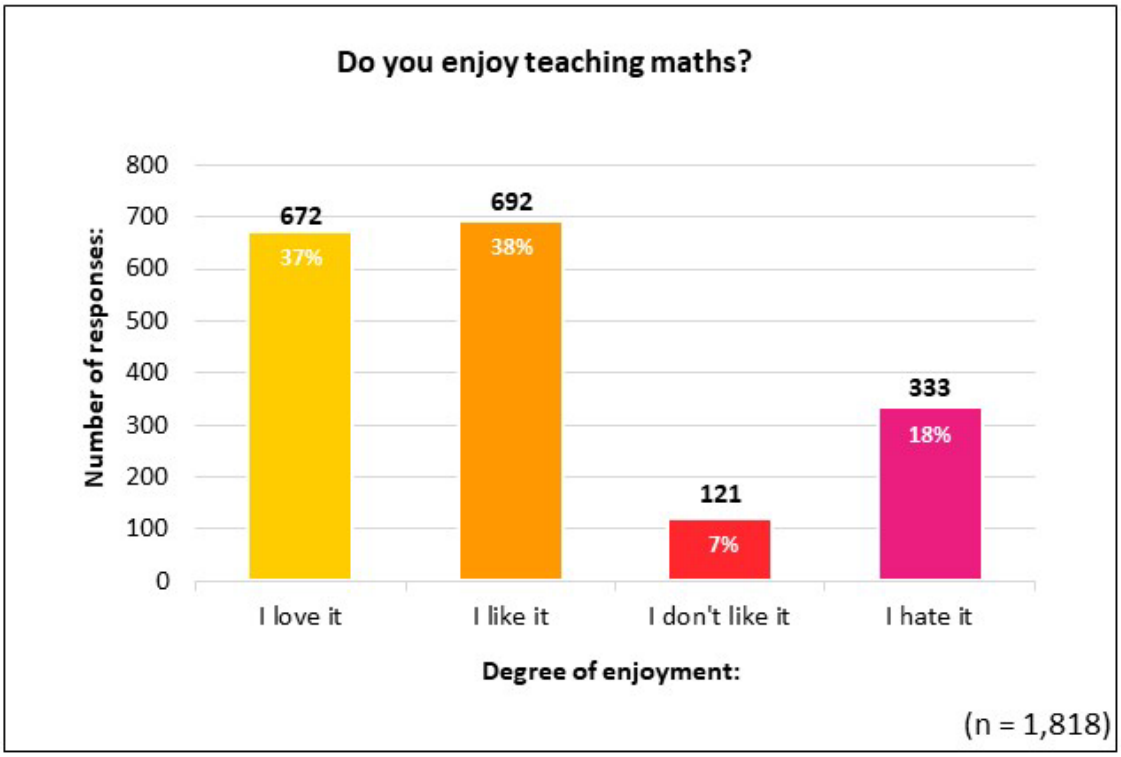

How important do you think the role of the teacher is in providing quality maths education?
Number of responses:
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
1,630
87%
232
12%
3
3
Very important
Important
Not very important
Not at all important
Degree of importance:
(n = 1,868)


Would teaching maths ever put you off taking a senior class?
545
28%
1,419
72%
Yes
No
(n = 1,964)


Did your teacher training provide you with adequate skills to teach maths in a senior classroom?
452
23%
1,475
77%
Yes
No
(n = 1,927)


Do you think the maths book is an effective tool to teach maths in the senior class?
503
33%
1,020
67%
Yes
No
(n = 1,523)


How often do you have active learning in maths in the senior classroom?
(For example: using concrete materials, group work, mini whiteboard activities etc.)
Number of responses:
500
400
300
200
100
0
298
21%
470
33%
472
33%
194
13%
Every day
Most days
Once or twice a week
Rarely
Frequency used:
(n = 1,434)


Do you enjoy teaching maths?
Number of responses:
800
700
600
500
400
300
200
100
0
672
37%
692
38%
121
7%
333
18%
I love it
I like it
I don't like it
I hate it
Degree of enjoyment:
(n = 1,818)

Instagram Survey – Record of Written Responses

Question 9 - What does effective maths teaching look like?

Colour:	Code:
	Teacher Modelling/ Direct Instruction/Role of the Teacher
	Child-centred/Active Learning/Fun/Hands-on/Engaging
	Concrete Resources
	Maths Talk
	Differentiation
	Real Life
	Assessment/Prior Knowledge

What does effective maths teaching look like?
Everyone engaged working at their level
Hands-on, real-life examples
Modelling and Peer tutoring, Maths stations
Explicit teaching of topic using concrete examples and concrete language for all features of topic
setting out what class(es) will be covering in topic at the start of week
Discussion, modelling, independent discovery, using math language, games,practicl
Teacher modelling followed by group work. Lots of hands-on resources and lots of talk
Stations can be amazing for senior classes for both teachers and students
Active, collaborative learning which is related to real life as much as possible.
Relating it to real life, teaching math language, making it engaging
Children's voices - number talk. They listen to each other.
Mini whiteboards a MUST to see understanding number at a glance. NUMBER TALK
Children engaged and enthusiastic
engaged children and active participation
active where possible, and project based - for consolidation
some teacher modelling and lots of student and teacher-guided exploring and using.
Model, explain, have a go, model explain have a go, independent work if ready or back to our boards.
Lastly plenty of I do, We do, You do. Don't waste too much time with discovery learning
Also, Lots of problem pairs, teacher does worked example children then do one ind.
Lots of stuff from Corbett Maths and I See Reasoning by G Metcalfe
Active, fun, games - approach if poss, hands on, examples, guided discovery & encouraging "mistakes"
Hands on problem solving and teamwork
Really explicit and systematic and never assume they know anything. New topics with simple numbers.
1. All about Gradual release of responsibility, need lots of practice and have to not be afraid to go back.
2. And starting where your class are at rather than where the book says they should be at.

3. Also all about building their confidence.
Positive attitude
Being positive about the subject and making connections between classwork and real life maths.
The kids can link different areas and decide a couple of ways of solving a question
Prior knowledge, modelling, they do examples, independent work, support where needed
Lots of concrete resources and active learning with collaborative activities
The children understand the concept and can explain it themselves
Children's engagement. In class support to aid differentiation.
Students using skills and concepts from previous chapters to infer learning.
Each child working at their own level and children reasoning with key vocabulary
Like secondary school show workings, process, why, reasoning, question others
Trial and Error and multiple methods. No one way is right. It's a process not just a end ans.
Where the teacher enables students to become their own teachers
Going thru all answers in our daily mental maths!!! Better than Sese lessons
Children being brave enough to tackle problems independently
Engaging pupils, building confidence
Children engaged and enjoying the lesson
Engaged pupil - inspired to learn
Explanation/discussion, lots of hands-on materials, relating to real life, practice!
Kids "getting it! and enjoying it
Lots of mini whiteboard work, constant praise 'not 100%, give it another try'
Hands on, use of concrete materials, active maths games
Hands on activities and children discussing variety of methods
accessible to all
my kids love playing detective n solving problems so making it fun is important
proactive, question based, child led, challenging
understanding skills and concepts and not just the rules and procedures
lots of 'maths talk'
Lots of talk and discussion first, investigation, child led then teacher-led examples, then practice.
Catering for all abilities whilst challenging children and keeping them engaged
Fun, Hands on!
Lots of mental maths and problem-solving strategies
Huge emphasis on layout of sums, how to structure copy page. It takes a few wks but soooo worth it!
Peer learning/maths games/engaging/problem solving/ real life maths
whiteboards, games, independent, group work, reflection on L.O and challenge
child led investigations where they lead the learning
Lots of reasoning, sharing strategies and persisting with challenge. Growth mindset.
games activities, warmups, frequent revision questions!
Clarity
Explicit teaching per topic. Use of concrete materials, related to everyday life examples
PDST resources for maths are excellent
Fun, engaging, collaboration, problem solving, active
Lots and lots of use of mini whiteboards!! Plenty examples to practice
Hands on learning. Collaborative learning

Modeling, conference between pupils, solid examples, pupils sharing idea
Practical real-life application
Involving the children in practical maths as much as possible. Very difficult to do at higher end
Practical applications and fractions, decimals and percentages are the cornerstone
Warm up game, teaching new skill, paired work/whiteboard work, finish with copy.
hands on experiences/activities. Pupils working things out - discovery learning. Playful
Active lessons!! Relate the Maths to real life as much as possible!
If you find the answer to this tell us lol
Engaging activities, differentiating to cater for all needs
active learning
Teacher modelling - group/pair work - individual work
opportunities for mathematical thinking out loud, collaborating and solving problems together
Active, real life tasks and problems to solve. Fun puzzles, maths mysteries, trails.
Gradual release of responsibility leading to independence as much as possible.
Hands on learning. Focus on Problem solving and reasoning. Little to no reliance on textbook.
Big focus on problem solving - it's more about the process rather than giving the correct answer
Children engaged and interested, hands on materials, when you hear kids talking about maths in real life!
Games based, real life maths. Text books only go so far.
Using real life maths away from a book
The children being able to explain why, not just how to demonstrate understanding
Fun and interactive
Practical hands on activities, mixed ability group activities and problem solving!
1/2 Where you expose children to a range of opportunities to apply skills whilst also
2/2 revisiting skills regularly to allow children to consolidate
concrete materials, pair wok, group work and lots of support
Hand on learning using concrete materials. T model, chn with T, chn independent.
Mixture of teacher-led/Hands on learning
Inquiry based - practical and hands on as possible (in an ideal scenario, resources avail.)
Trial and error, finding solutions together
Hands on and interactive
Use of maths language, model examples and kids use own whiteboards. Games based on topic.
Hands on & practical experiences is paramount, experience of using operations in context
Hands on active learning
Hands on lesson using concrete materials
mix of games and everyday problems
children problem solving with concrete first, group work
showing the process
lots and lots of problem solving activities in every topic.
ability groups seated together and small group differentiated instruction at least twice a week.
A mix of teacher-led and hands on games!
Using games to consolidate learning and teacher modelling also

Child led, explorative, lots of questions
Children active, listening, observing, concrete materials, pen and paperwork at different stages of lesson
Modelling examples on the board
Good mental maths skills
Free exploration of materials & games in senior end. Emphasis on real life maths.
Problem solving skills and strategies
Engaged children participating to their abilities
Children being able to explain a concept to the teacher or a buddy
Active, Hands on learning
Busy!! Or a mental classroom
The children feeling confident that they understand and can attack problems
Concrete hands-on & ability to understand and explain concepts using mathem lang
Clear objectives. Helping the children form connections, understanding the concepts
Whiteboard work before copies.
Hands on, concrete, visual, realistic
Questioning how they got the answer
Scaffolding, directing 'hands on' learning with a purpose
Engaged children, enjoying maths learning
Engaged children. Differentiation. Mini whiteboards. Pair and group work. Over teaching tables and and maths fac
Explicit teaching of methods as well as tips/tricks and lots of time for children to practice
Being able to teach fast/early finishers and rest of chn equally
Teacher modelling the concept. Then the pupils working on concept either individually or in gr.
Having adequate resources for the senior classes that would help with the topic. Although for some topics like x o
Breaking things down and visual aids
Active learning.
Hands on, learning from teacher and pupils, concrete materials
Relate to real life
Team teaching to mop up difficult topics
Involving the children. Explicitly leaching & modelling but then letting the children do it @board on mini whiteboa
Children using a variety of strategies and maths talk
Structured step by step approach
Children get opportunities to explain how they got their answer and peer teaching
Modelling the new procedure. Practicing on mini whiteboards. Independent work
Hands on activities as much as possible, applying concepts to real situations before doing sums
Engaging introduction - game/active learning/ open ended problem solving
Hands on, concrete resources, practical tasks, relaxing to real life examples
Pupils retaining skills and relating them to future lessons
Engagement in problem solving and critical thinking
Active learning, busy kids, using different skills
use of manipulatives and connecting it to the real world
CPA (Concrete, Pictorial, Abstract)
Actively engaged and differentiated

The gradual release of responsibility model with each step of concrete, pictorial, abstrx
An active room with lots of discussion
a lot of talk between teacher and student, a shared pen approach
Hands on materials and focus on language
Having concrete resources for teaching maths topics
Working together to solve rich mathematical problems
Active
A balance of oral, practical and written tasks where every child is working at their own level
Making connections to real life maths/in the environment/daily life
Peer teaching, hands on, life real relevance
hearning the maths language being spoken by the children. Having a rich maths are in the room that is a
Lots of ALF communication, self-paced; self-correction with calculators; discussion; games.
Investigative - Maths no Problem is amazing
Using maths materials, practical hands on activities, children working together.
Excelling modelling, active learning, loads of practical activities
Concrete-pictorial-abstract
Hands on and positive
Concrete learning, modelling the sums to pupils, concrete, putting it into practice and completing Qs
Being able to teach one thing in many different ways
Teacher modelling, scaffolding, pair work, group work, individual work… Lots of oral language… Discussion
Children figuring out problems together!
Hands on, concrete materials
Lots of modelling, explicitly teaching and naming mental maths strategies, practical exp
Teaching problem solving and logical thinking
Getting children to discuss and show others/ or the class how to do particular things
Teacher modelling. Hands on work. Games. Manipulatives. Daily word problems. Correct maths language.
Peer learning.
Ensuring the understanding is there not just the process of calculating so they can transfer
Active/Teacher modelling but I find the senior maths very book/context heavy
Lots of lightbulb moments with the children. Them offering to show you another way.
Hand on activities, working in groups or pairs. Actively learning.
Lots of hands on manipulatives
Hands on experience, discussions and explicit teaching and modelling
Layered approach to new concepts and procedures. Regular feedback from children to gauge their understand an
Providing a problem at the start of the lesson. Assessing. Then adjust the lesson accordingly.
Games, stations, whiteboards, markers, lots of group work and chat!
Mathematical language clearly visible and correctly used when teaching topics
Teaching children there are many methods to do maths… so many are reluctant to try

Lots of examples, thinking aloud, asking pupils WHY they're doing something...so much of the time they can apply
Children not getting frustrated. Active learning.

Instagram Survey – Record of Written Responses

Question 10 - What do you find most difficult about teaching maths in a senior class?

Colour:	Code:
	Time/Covering everything/Curriculum Overload
	Differentiation/ Catering for different abilities.
	Gaps in knowledge/ lack of automaticity
	Difficulty making learning fun/engaging
	Pupil Attitude
	Lack of resources
	Teacher knowledge

What do you find most difficult about teaching maths in a senior class?
Difference in ability and understanding. Missing of basics.
Huge range in ability level and massive gaps of knowledge due to Covid
Differentiation for high ability that is challenging but fun.
Multiclass 3rd - 6th. Getting everything taught and corrected!
Different levels - finding a happy medium
Access to resources and materials.
Fractions
Class are very weak/retention
When kids haven't learned their tables, makes so many concepts more challenging for them.
Modelling examples for the children and having lots of one-to-one time with them
Textbooks available. Some topics are done well in different books.
SET support (or none!)
Time allotted
I have 5th and 6th and I need more time. The course is so big it's hard to get it all covered.

The range of abilities and concepts
Helping these children and have at their own level while not making them feel conscious.
The gaps that are there with regard to ability become much more obvious
The amount of content to cover (during covid so maybe better on normal years)
Making the abstract concepts concrete
Word problems
The lack of automaticity with number facts which leads to inability to spot patterns
Squeezing in all the content and trying to make it fun too.
Time… So hard to squeeze everything in.
Varying abilities, trying to challenge higher groups while also support lower groups.
Range of abilities
If they don't have their times tables/number facts quickly it can really make it difficult.
Getting them to practice extensively without it being boring
Keeping children engaged when dealing with difficult or 'boring' topics like operations
Getting time to correct work and go through examples they completed together.
Lack of time to do things like play games etc. Heavy curriculum load in the senior classes.
Trying to attend to all levels. Also, curriculum overload
Having appropriate resources and manipulatives
Amount of content to cover means not everything gets the time it needs for children to grasp concepts.
Need time. Sometimes to work out question yourself, can be caught off guard.
The HUGE range of levels on both ends of ability.
Making the lesson more practical as I find lots of topics need to be taught explicitly.
Trying to email the wrote methods what we know - due to how we were taught.
It takes a LOT of time. We do one full hour first thing every morning.
The explanation
Trying to make it fun
Any of new concepts to be covered/trying to balance time spent on maths lessons
Children with a negative 'I hate maths' or 'I'm no good at maths' attitude.
The variation in levels across a multigrade… some strong 6th level others at 2nd.
Finding multigrade (5th/6th) difficult, so much new stuff for 5th! And time constraints.
Covering everything in time.
Time pressure to complete content that you can't always spend extra time on topics that need extra attention
Engagement
Challenging the strong ones while supporting the weak ones.
Trying to reword my understanding to make it understandable/relatable to them.
The varying levels of ability within the class. Hard differentiate such varying ability.
Preconceived ideas from children that they're 'bad' at maths.
As always - TIME! Maths could be taught all day every day but obvs not possible!
Not enough time to cover the curriculum.
Catering for everyone
Different levels.
There is very little correlation between 6th class maths and 1st year maths. Very frustrating.
Wide range of abilities within one class.
Love maths

Division, long multiplication, decimals, fractions, complex word problems.
Split classes/ differentiation
The gap widens as the children get older
Pupils attitude to maths, not wanting to tackle problems.
Fractions, decimals and percentages. It's difficult to make it fun and interactive.
How abstract it can be!
Wide range of abilities.
The varying abilities
Engagement
Not enough hours in the day!
Finding suitable resources and concrete materials for 5th/6th class maths
Mixed classes esp a 4th and 5th combination.
The pace of the 5th class curriculum. The kids have to have very solid foundations going in!
The difference in ability between children. Some very advanced, some cant do basic multiplication/division.
Overloaded curriculum in 5th class - always feel behind - kids who struggle feel overwhelmed
Explaining fractions and percentages
Having an out of date maths book. Have to supplement a huge amount to address problem solving etc.
The maths!
Not teaching the way we learnt in school
Differing levels of ability
Different abilities at that age
Managing the range of abilities in my class
The corrections
The amount to be covered.
Big classes, lack of concrete materials BUT I love teaching Maths. My favourite subject!
The amount to be covered. 5th class especially.
Tables
Challenging top group and supporting weaker groups
Time constraints
Varying abilities.
Covering all content
The time - I feel it takes a lot longer than the time assigned by the department
The different levels within a class. Hard to get to everyone .
Not enough training in college! Getting a grasp on the content myself before I teach it to them
The ability gap
Curriculum overload in 5th
There is a lot to cover!!!!
Differentiation
Ability levels in the room. Very weak and very able kids.
Differentiation
Motivation. 'Ah sir, I'll never use this in real life'
So content heavy, especially in 5th
Too much new things in 5th. Should push some back to 4th. and push 4th back to 3rd etc

That some kids will never "get" some aspects of a topic but you just have to move on.
The varying ability levels - can be difficult to meet all needs
Word problems - hard to explicitly teach. rubrics help to improve achievement but not always.
Getting buy in from the children when it comes to the more abstract topics… that they may never need!
The range of abilities
You have to be relentless to get through all of the material effectively. V. little room for manou
The amount of content. Problem solving too.
The varying levels.
Tables.
Afraid a student will ask a question I don't know the answer to.
The vast curriculum
Resources
The huge amount of content in 5th!
When basics (tables, number concept etc) are missing it makes decimals, fractions long division and multiplication
Differentiation
The breadth of the curriculum!! Way too much in 5th and 6th.
Making it fun while also getting the students to practice
Huge curriculum - have to keep moving quickly to get it covered
I love it!
Differentiation
Problem solving
Catering to the vast differences in abilities
Multi grade class. Varying abilities and having time to get around to all those who need extra help.
So much to cover in the curriculum. Multigrade 4th, 5th and 6th. Big jump from 4th to 5th.
For me, having a big discrepancy between abilities - how best to support the development of all
Trying to make the content fun and engaging as there is so much to cover and lots of new content in 5th.
Decimals and fractions. Children find those topics difficult to understand.
Age and attitudes- children reluctant to contribute at times.
Other adults showing them "their way"
Catering for such a vast range of abilities
Trying to make it more fun, boosting their self esteem
Covering the curriculum
Differentiation
The book!
Different abilities ranging from very low ability to children that could be doing secondary work
Catering to a range of abilities in a large class.
The constant worry of making sure we're getting through the textbook.
Differentiation
Equivalent fractions.
Fractions and operations, hard to make fun and my own weaker areas
It's so content heavy and has long workings so it's tough to find fun/ hands on games to

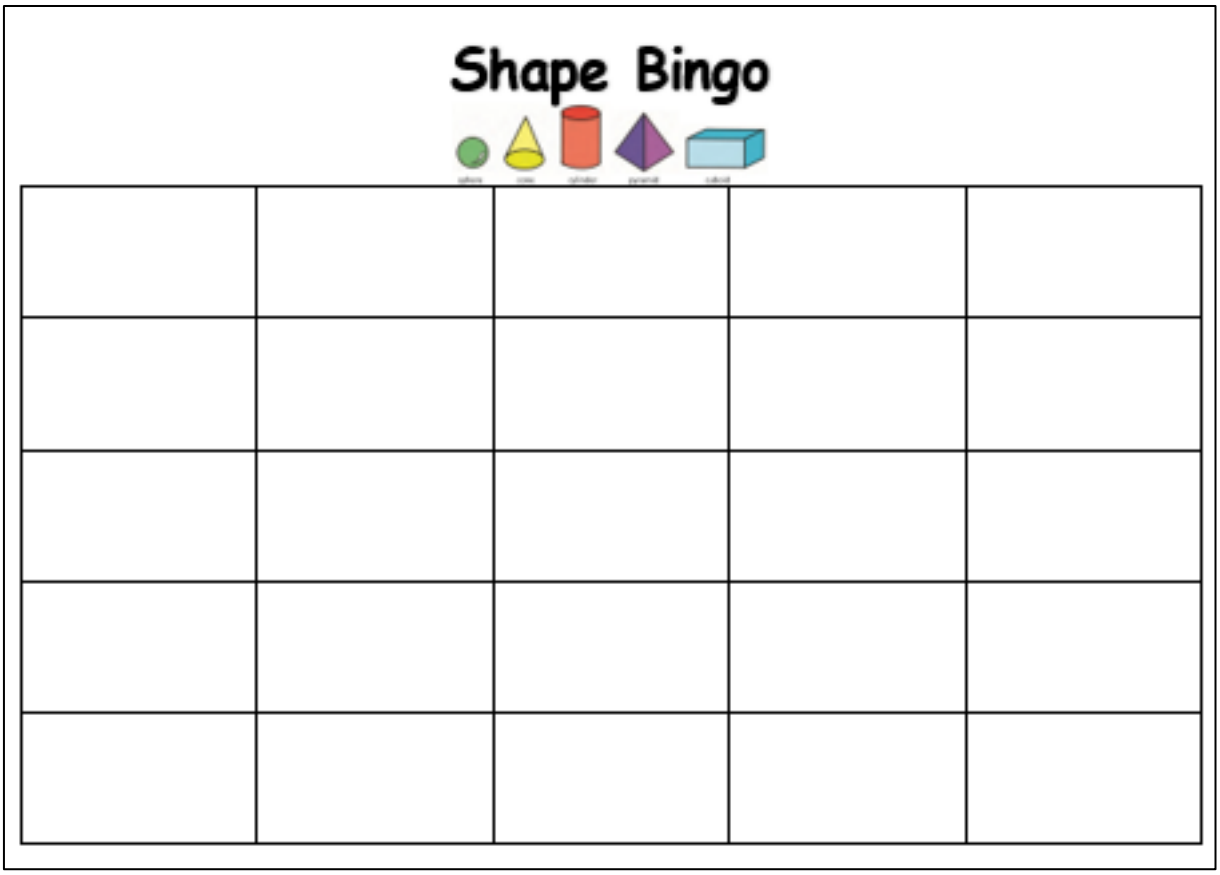
teach the topics.
Making it fun and interactive when a lot of it just has to be LEARNT.
The volume of work to get through. I teach in a multigrade 3rd to 6th class and it's difficult to get through.
Percentages, Problem solving
Differentiating to meet all needs
Curriculum overload
Spending time researching engaging activities. Ensuring I understand it myself!!
Differentiation
Corrections!!
The range of abilities/constant differentiation
Attitudes towards maths at home. Basic blocks have being missed in other classes.
When there are extremely bright children. Feel I don't have enough knowledge at times.
The varying abilities
Topics of extension work.
Profit/loss, fractions, also if students don't have their tables/number bonds difficult to explain.
The massive gap from lower achievers to higher achievers and catering for them all.
Differentiation.
Too much content
Class size too big, hard to get to every child.
5th class - too much to cover. Kids don't have basics (such as tables, basic fractions, etc,)
Time constraints and difference in ability
Time, resources, support
Lack of knowledge on how best to teach it and level of difficulty
Various levels in the classroom.
Differentiation.
Differenetiation. I teach 3rd/4th but have boys in my class working on junior infant all the way up work.
Volume of work - a whole year in infants to learn 5 numbers, then the kitchen sink in 6th!
Making it fun.
5th class is very content heavy. Huge jump in fractions and decimals and change from concrete to abstract mat
The curriculum is so broad there isn't enough time for hands-on practical activities.
The difference in abilities
The varied ability levels in the classrooms - hard to challenge HA kids while working with Las
Breath of curriculum
Being able to teach ALL kids so others aren't getting left behind and e.finishers are busy too.
It's a lot of chalk and talk and textbook.
Time. Trying to give help to all who need it.
Problem solving
Knowing how to do them
Having enough hands-on resources
Getting it all covered.
Lack of resources, loads for younger kids.
So much to cover!! Esp difficulty in multigrade senior class.

Huge amount of new content in 5th class…
I wonder if I'm challenging more able students enough sometimes.
Balancing those who are able for the curriculum and those working on more basic concepts.
Someitmes they don't love it as much as me… but I usually win them over a little during the year.
Maths anxiety and pupils saying I'm no good at maths.
Differentiation. Some children finishing super quick while some can't do it at all.
The time it takes for corrections and fractions/decimals/percentages. Pupils find it v difficult.
Kids enjoyment/ interest in learning maths
I don’t have the best maths brain and some 5th/6th class maths word problems can be head scratchers.
The extreme range of abilities.
Not enough resources! Huge spectrum of ability.
Time to cover the curriculum. Real life maths difficult (money, time etc) as they are not having daily/regular exp
Word problems.
No structured approach for team teaching.
Differentiation and time one to one.
Getting through to the weaker children who have so many gaps in their knowledge.
Other teachers saying they need to rote learn maths topics.
Correcting and having more sums to practice.
The volume of new material in 5th and the weakness in language for problems.
Heavy curriculum. Need to spend 1 hour a day to really do maths.
Difference in ability.
Kids listening to you. .
Different ability levels in multigrade classes and maths books not user friendly.
Challenging the brighter kids.
Huge range in ability and prior knowledge.
Relating it to real life and still following the process. I feel they sometimes get the process but cannot relate to
Differentiation.
Many children still don't know tables which makes teaching number operations difficult
Too many topics and not enough time.
Getting the balance right between the ones that get it instantly and the ones who need a bit more 1 on 1.
Suitable games. Hands on activities for 6th
Making it active and interesting.
Some of the problems and helping the children who struggle to solve problems independently.
Fractions, decimals and percentages and word problems that contain all 3 elements.
Moving on! Always have a few that haven't fully grasped the concept.
Teaching long multiplication/division. Using concrete materials; differentiation.
Not enough time… not enough resources.
The fact that the primary curriculum and the secondary curriculum can be so different - tough for transition.
mathematical language
The range of abilities
Helping children who can't grasp the concept!! And are struggling.

Amount of content.
I have 4 classes and just feel the sheer amount of content is overwhelming.
5th class - a lot of content to be covered in one year.
Long division.
Different abilities: the gap widens so much.
Differentiation.
Range of abilities, catering for all.
Lack of enthusiasm and in some cases lack of children knowing their tables.
Lack of confidence in my own ability
Pace. Knowing when to move on, even when weaker students haven't grasped it.
Lack of concrete materials.
Lack of hands-on resources.
Explaining the more difficult concepts when you can't use concrete materials to help
Inadequate maths resources in school. Not enough for a whole class.
Lack of practical resources in my school for senior classes.
Access to resources. The wide gap between lower and higher ability.
Time restraints.
The 'block' - when kids zone out out of fear of getting something wrong.
Lack of concrete resources.
Time.

7.8 Appendix VIII – Samples of Games, Worksheets and Activities Used.

This appendix includes examples of games and resources that were used in the maths lessons during the intervention.



Length - Measuring

Find some items in the classroom that are approximately:

1 metre long:

- _____
- _____
- _____
- _____
- _____

1 cm long:

- _____
- _____
- _____
- _____
- _____

10 cm long:

- _____
- _____
- _____
- _____
- _____

Record the Length, Width and Perimeter of these items:

Table:
Length: _____
Width: _____
Perimeter: _____

Maths Book:
Length: _____
Width: _____
Perimeter: _____

Maths Copy:
Length: _____
Width: _____
Perimeter: _____

Window Pane
Length: _____
Width: _____
Perimeter: _____

Choose four more items to measure:

Item: _____
Length: _____
Width: _____
Perimeter: _____

Item: _____
Length: _____
Width: _____
Perimeter: _____

Item: _____
Length: _____
Width: _____
Perimeter: _____

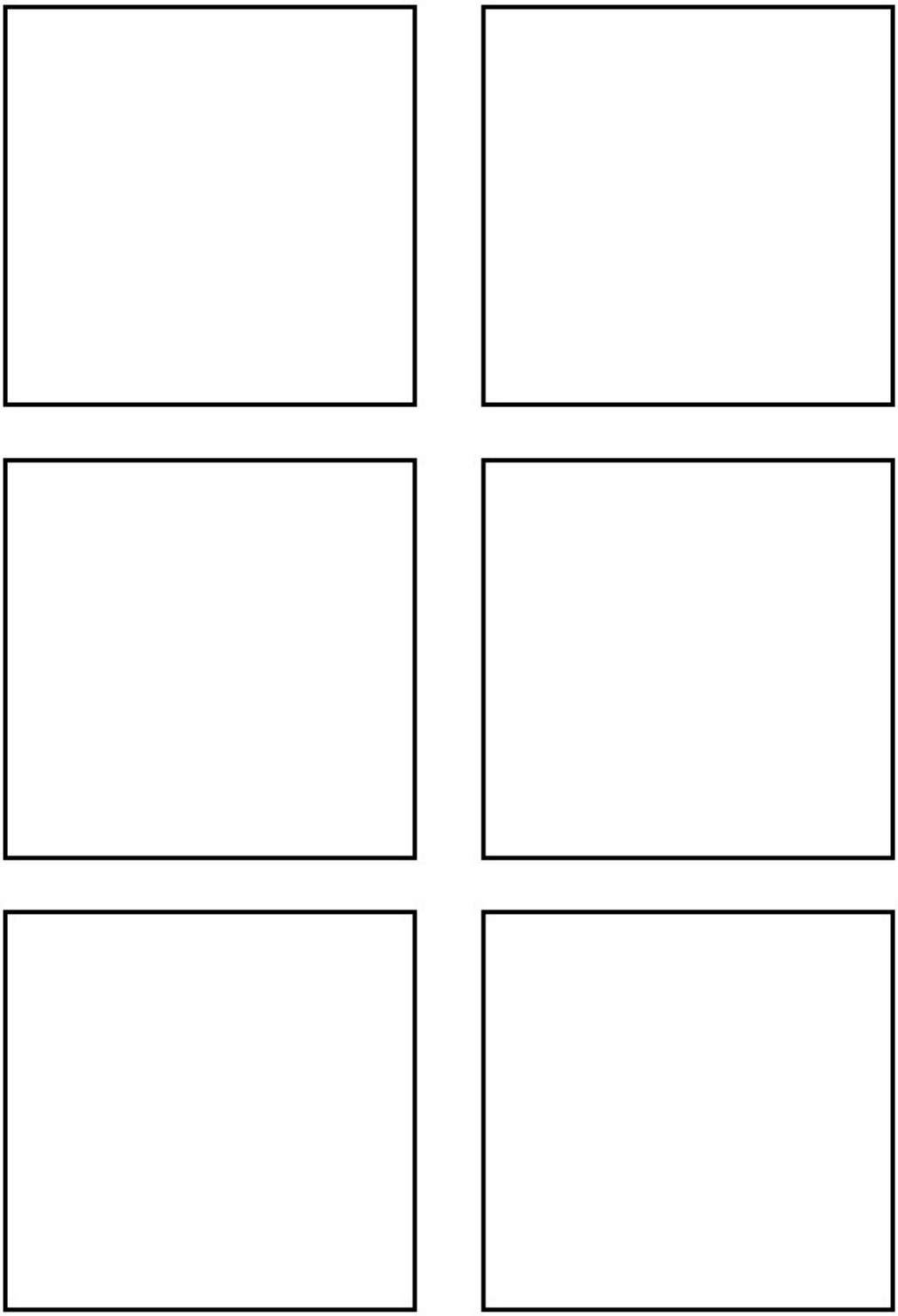
Item: _____
Length: _____
Width: _____
Perimeter: _____

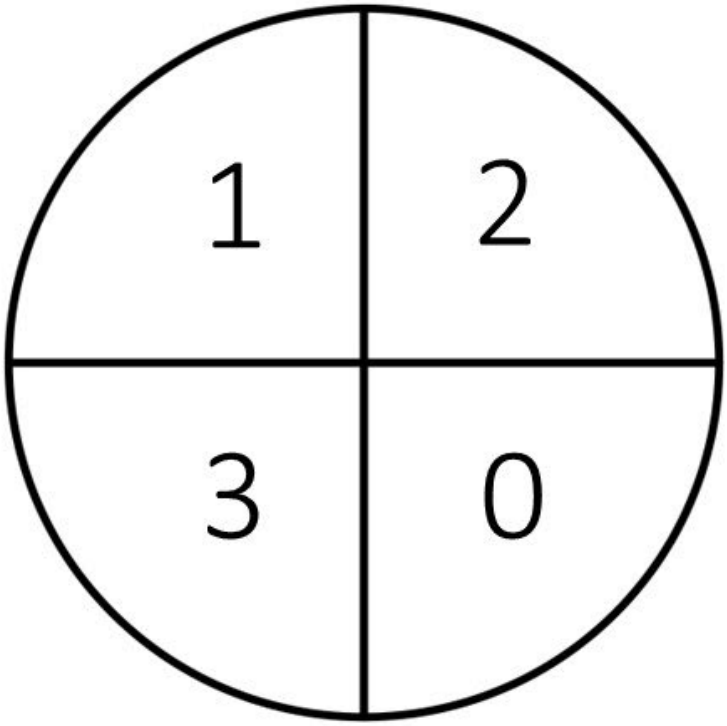
Length - Connect 5

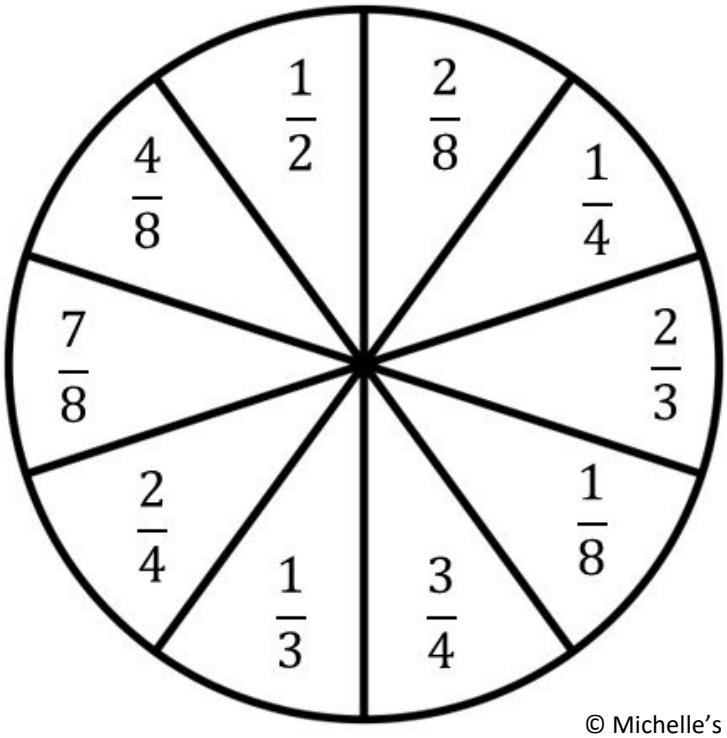
100cm	25cm	5cm
90cm	75cm	125cm
80cm	110cm	150cm
70cm	150cm	175cm
60cm	200cm	120cm
50cm	101cm	210cm
40cm	1cm	201cm
30cm	2cm	250cm
20cm	3cm	180cm
10cm	130cm	220cm
500cm	505cm	202cm

- Write one number in each box.
- Choose numbers from the list below.
- Place a counter on the number when you hear a match. ($\frac{1}{2}$ m = 50cm)
- The first person to have 5 in a row is the winner!

Draw the Fraction

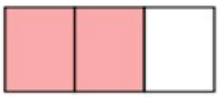




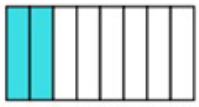


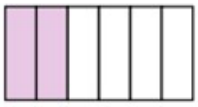
Identifying Fractions

What fraction is coloured?
What fraction is white?

1) 

$\frac{2}{3}$ colour $\frac{1}{3}$ white

2) 

3) 

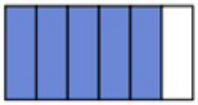
4) 

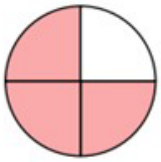
5) 

6) 

7) 

8) 

9) 

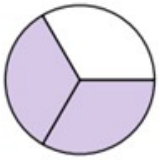
10) 

11) 

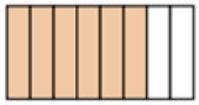
12) 

13) 

14) 

15) 

16) 

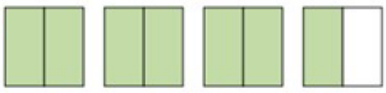
17) 

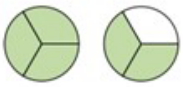
18) 

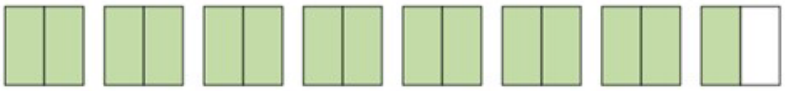
I can read write fractions as a mixed number or an improper fraction.

What fraction is green? Write as an improper fraction and a mixed number.

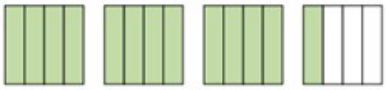
A.

1)  Example: $\frac{7}{2}$ or $3\frac{1}{2}$

2) 

3) 

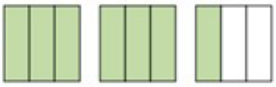
4) 

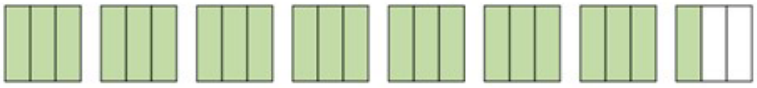
5) 

B.

1) 

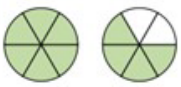
2) 

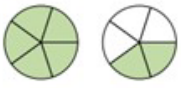
3) 

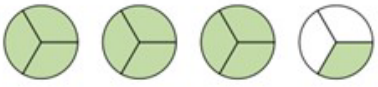
4) 

5) 

C.

1) 

2) 

3) 

Adding Mixed Fractions

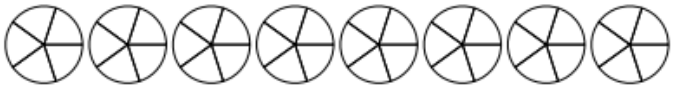
Use the visual model to solve each problem.

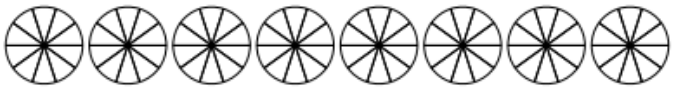
$1\frac{3}{5} + 2\frac{4}{5} = ?$

To solve a fraction addition problem one strategy is to shade in the whole amounts first (1 & 2).

Next fill in the fraction amounts ($\frac{3}{5}$ & $\frac{4}{5}$).

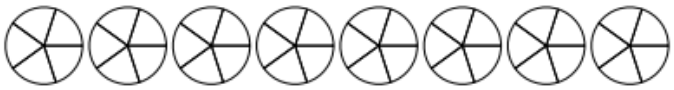
When all of the pieces are filled in we can see that $1\frac{3}{5} + 2\frac{4}{5} = 4\frac{2}{5}$

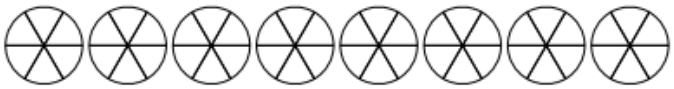
1) $1\frac{4}{5} + 2\frac{1}{5} =$ 

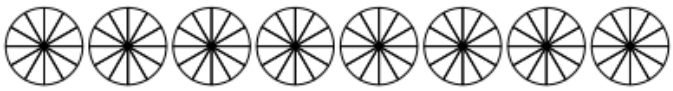
2) $1\frac{1}{10} + 2\frac{8}{10} =$ 

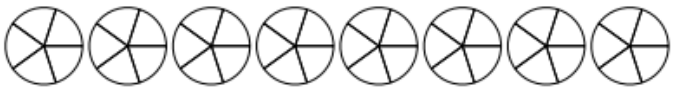
3) $2\frac{3}{4} + 3\frac{1}{4} =$ 

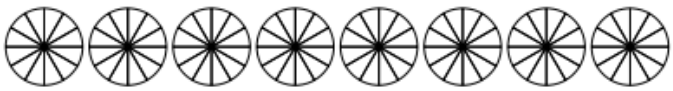
4) $3\frac{1}{3} + 2\frac{1}{3} =$ 

5) $2\frac{2}{5} + 1\frac{4}{5} =$ 

6) $1\frac{4}{6} + 3\frac{1}{6} =$ 

7) $1\frac{4}{12} + 1\frac{2}{12} =$ 

8) $2\frac{3}{5} + 1\frac{3}{5} =$ 

9) $1\frac{10}{12} + 3\frac{2}{12} =$ 

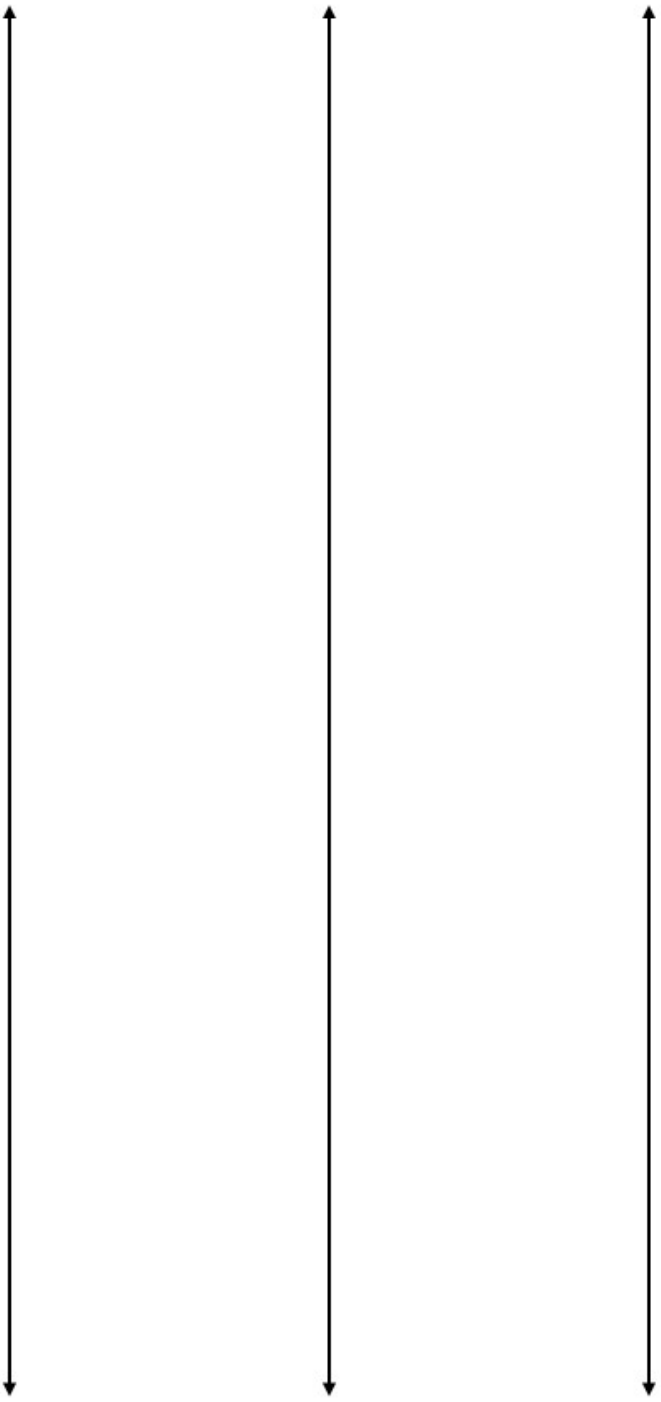
Source: https://www.commoncoresheets.com/adding-mixed-fractions-visual/409/download?version=1

Source: https://www.commoncoresheets.com/adding-mixed-fractions-visual/409/download?version=1

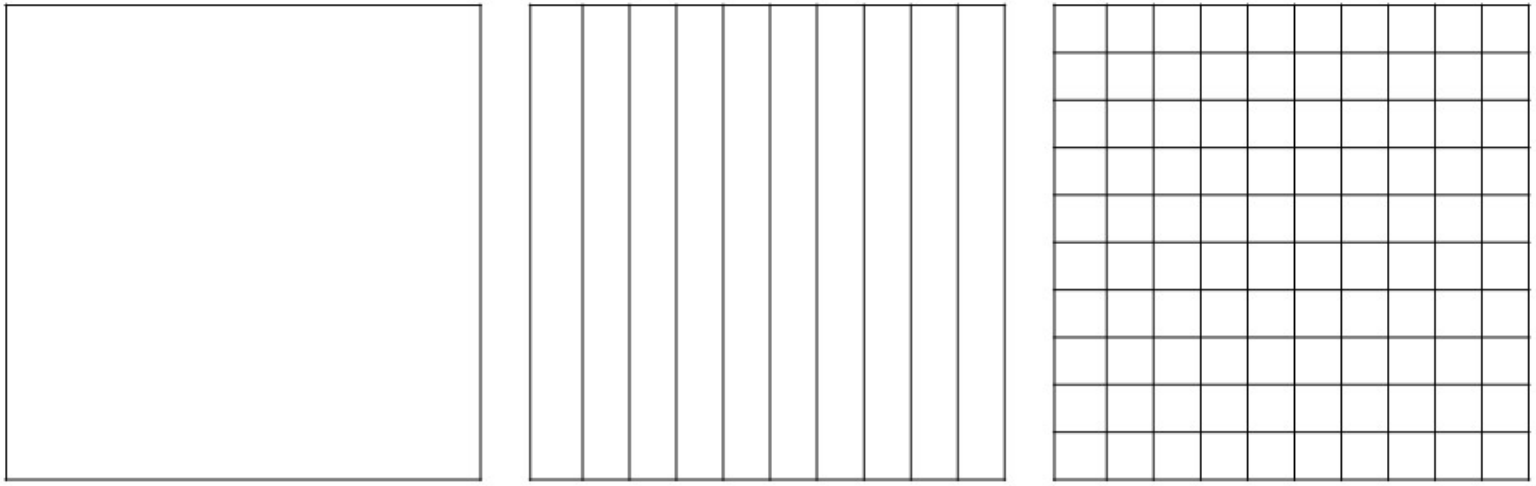
$\frac{1}{2}$	$\frac{2}{2}$	$\frac{1}{4}$	$\frac{2}{4}$	$\frac{3}{4}$
$\frac{4}{4}$	$\frac{1}{8}$	$\frac{2}{8}$	$\frac{3}{8}$	$\frac{4}{8}$
$\frac{6}{8}$	$\frac{7}{8}$	$\frac{8}{8}$	$\frac{1}{3}$	$\frac{2}{3}$
$\frac{1}{6}$	$\frac{2}{6}$	$\frac{3}{6}$	$\frac{4}{6}$	$\frac{5}{6}$
$\frac{6}{6}$	$\frac{1}{9}$	$\frac{3}{9}$	$\frac{6}{9}$	$\frac{1}{12}$
$\frac{3}{12}$	$\frac{4}{12}$	$\frac{5}{12}$	$\frac{6}{12}$	$\frac{8}{12}$

$\frac{9}{12}$	$\frac{10}{12}$	$\frac{1}{5}$	$\frac{2}{5}$	$\frac{3}{5}$
$\frac{4}{5}$	$\frac{5}{5}$	$\frac{1}{10}$	$\frac{2}{10}$	$\frac{4}{10}$
$\frac{5}{10}$	$\frac{6}{10}$	$\frac{8}{10}$	$\frac{9}{10}$	$\frac{10}{10}$
$\frac{1}{7}$	$\frac{4}{7}$	$\frac{1}{11}$	$\frac{10}{11}$	$\frac{11}{12}$

Fraction Number Lines



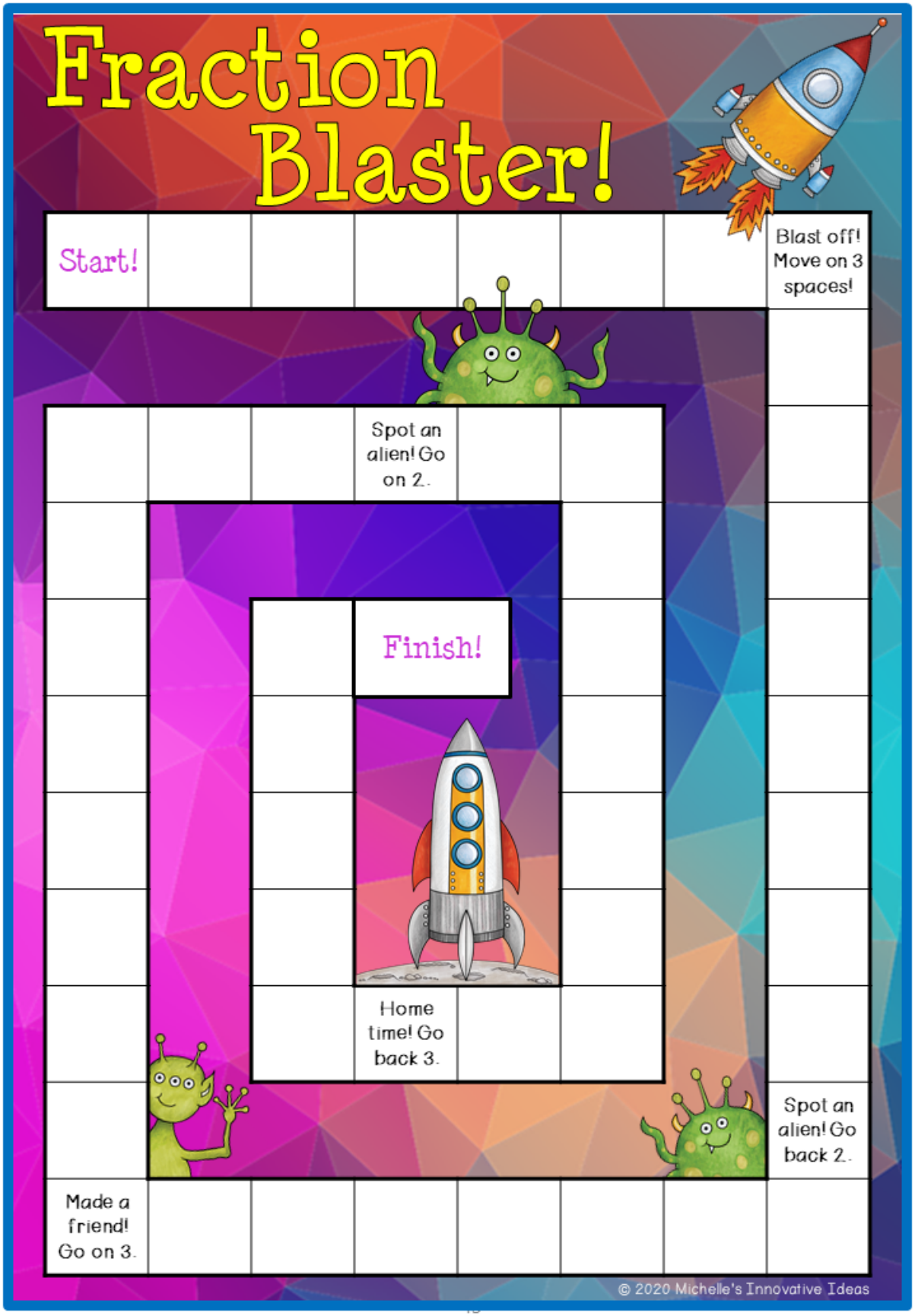
Reading Decimals and Fractions



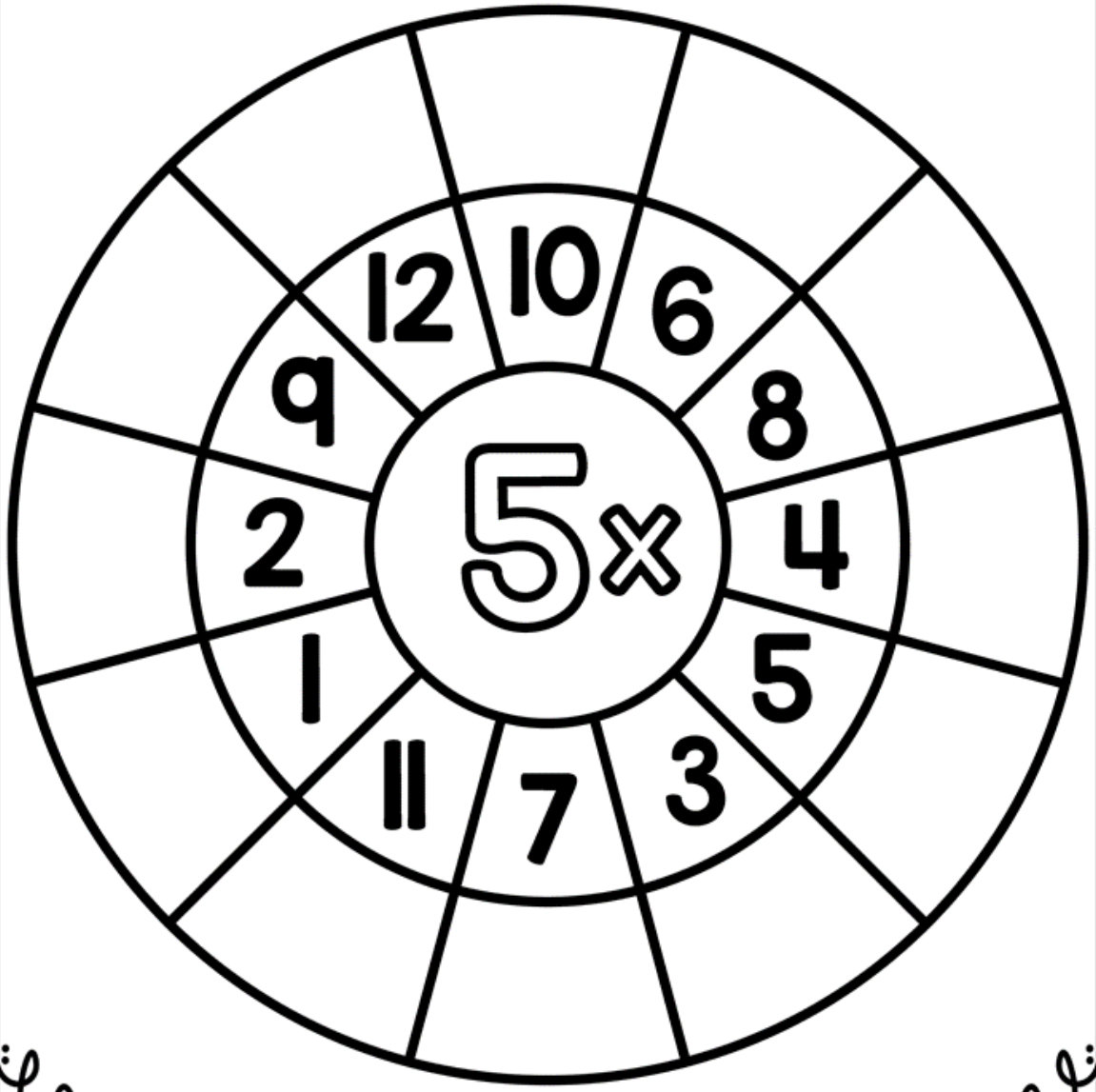
Fractions and Decimals
Connect 5

1.0	0.25	5cm
0.9	0.75	125cm
0.8	0.333	150cm
0.7	0.666	175cm
0.6	0.125	120cm
0.5	0.375	210cm
0.4	0.625	201cm
0.3	0.875	250cm
0.2	0.02	180cm
0.1	0.04	220cm
0.01		202cm

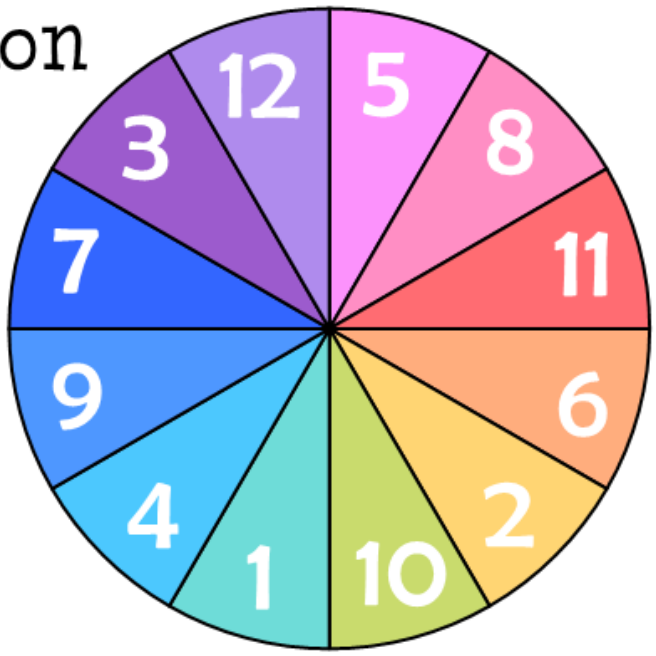
- Write one number in each box.
- Choose numbers from the list below.
- Place a counter on the number when you hear a match. ($\frac{1}{2}$ = 0.5)
- The first person to have 5 in a row is the winner!


Fraction Blaster!
Start!
Blast off! Move on 3 spaces!
Spot an alien! Go on 2.
Finish!
Home time! Go back 3.
Spot an alien! Go back 2.
Made a friend! Go on 3.
© 2020 Michelle's Innovative Ideas

Multiplication x5



Multiplication Squares Game



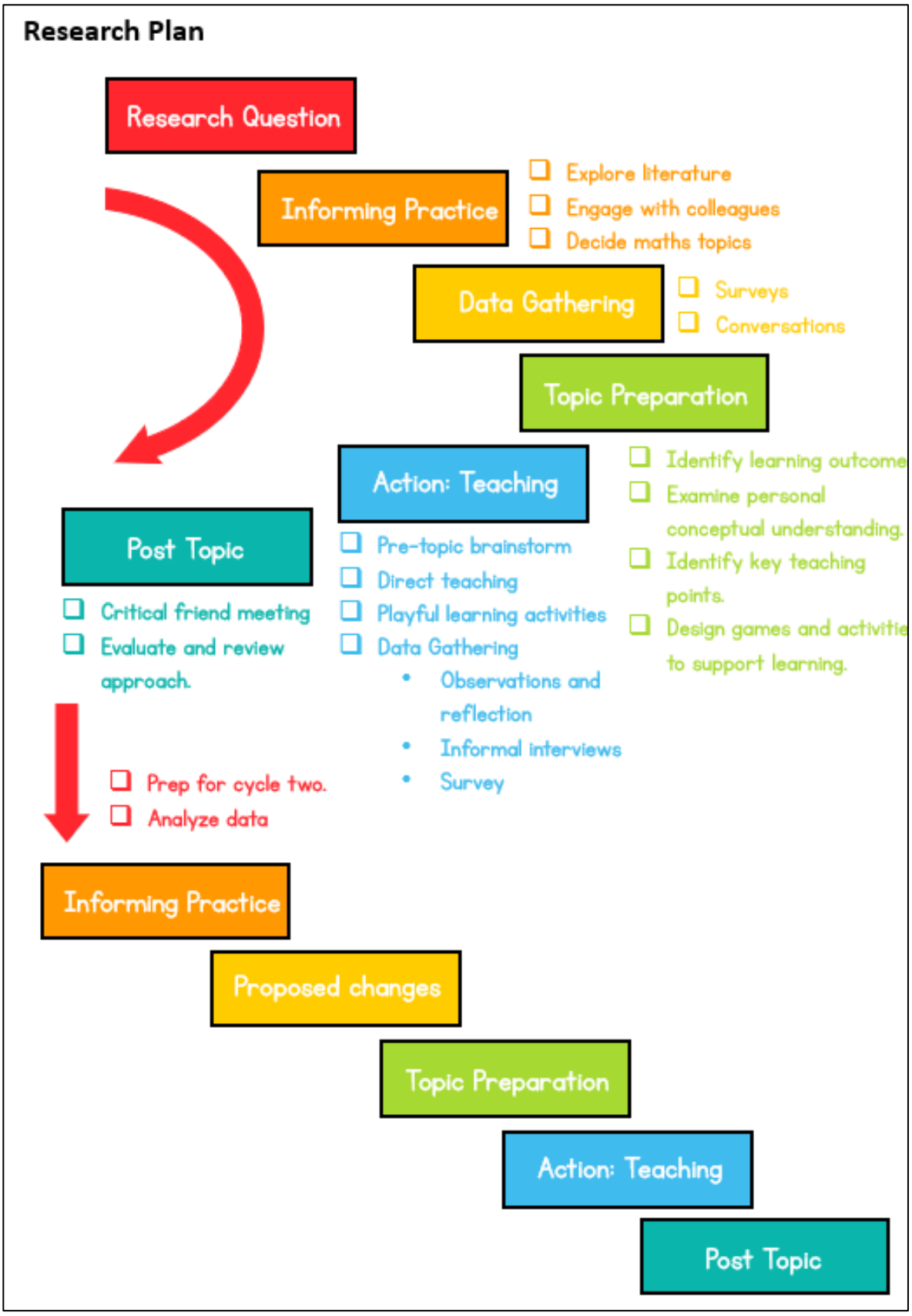
x4

4	32	8	24	12	28	16	40	20	48
36	20	44	4	12	8	20	28	40	24
40	4	28	8	32	36	24	12	20	16
48	44	8	12	4	20	28	32	16	24
32	36	40	20	28	36	16	4	12	8
4	12	48	44	20	24	8	36	32	16
40	28	8	16	48	32	36	4	12	44
8	48	20	44	16	28	40	12	24	4

7.9 Appendix IX - Research Plan and Timeframe

The table below shows an overview of the actions which were taken throughout the research.

Month:	Broad overview of actions:
August	• Research the methodology of self-study action research. • Start writing a reflective journal
September	• Engage in conversations with colleagues about our approach to teaching mathematics in the school • Submit research proposal
October	• Submit ethics statement • Reading literature
November	• Reading literature • Write and submit literature review • Ethics approval
December	• Identify mathematics topics for January – March • Restructure long term mathematics plan as a result of critical reflection on my practice based on the literature. • Conversation with critical friend about literature and current practice in mathematics. • Distribute ethics forms and explain research to children, parents and colleagues. • Reflect on reflective journal • Send a letter to the BOM
January	• Create an action plan based on evidence gathered • Meet with colleagues to talk about plan for mathematics teaching and learning. • Discuss plan with critical friend • Supervisor meeting • Review literature review
February	• Data gathering • Student survey
March	• Data gathering • Reflect on action plan. Modify
April - May	• Data gathering • Student interviews • Return to literature
June	• Discuss findings with supervisor • Conversations with critical friend • Presentation to validation group • Reflect on findings. • Begin writing discussion
July - August	• Conversations with supervisor • Writing thesis
	•



This research plan was designed prior to the intervention's start in late January 2022 and outlined the anticipated plan of action for the intervention.

7.10 Appendix X - Values Diagram

My values as shared during the presentation of my research to my colleagues and lecturers on June 11th, 2022.