Playful Mathematics in Senior Primary Classrooms

Research Report No. 1

Breed Murphy, Mira Dobutowitsch, Sorcha Browne, Sarah Porcenaluk, Natasha O' Donnell, Maja Haals Brosnan, Donncha Ó Corcoráin

Institiúid Oideachais
MARINO
Institute of Education

Contents

Research report

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Executive Summary

Recent developments in the *Primary Mathematics Curriculum* (NCCA, 2023) place a strong emphasis on play as a central pedagogical approach across all class levels, with each set of learning outcomes introduced by the stem "Through appropriately playful and engaging learning experiences." This shift positions playful learning as a core element of mathematics teaching rather than an optional activity, with playful learning identified as one of the five key pedagogies through which mathematical understanding is developed. In response, the researchers of this study were prompted to explore playful mathematics in senior primary classes. From the outset, they identified a notable gap in research on playful mathematics beyond the early years and recognised a strong need to investigate the perspectives of teachers and primary students on playful learning in mathematics in senior primary classrooms in Ireland. The study aims to identify effective approaches that support conceptual understanding and enjoyment, while also informing classroom practice and curriculum implementation.

The study adopted a sequential mixed-methods design. Phase One used online surveys with students and teachers to explore experiences and perspectives on playful mathematics in senior primary classes. Phase Two involved semi-structured interviews with key informants from mainstream and alternative settings, guided by themes from the survey data. Quantitative data were analysed in SPSS, and descriptive statistics were used to summarise participant characteristics and survey outcomes. Qualitative survey responses and interview transcripts were analysed using Reflexive Thematic Analysis.

The results were organised into six key findings areas. These areas revealed insights, including a strong association between playful mathematics and positive emotions such as enjoyment and confidence. They also showed that interpretations of "playful learning" vary, ranging from structured, teacher-led activities (often using games and manipulatives) to more child-led, exploratory approaches that integrate real-world contexts and children's

interests. In addition, child agency is often limited, with survey responses from children and teachers indicating that most activities remain teacher directed. Teachers reported significant constraints to effective implementation of playful mathematics, including limited time, inadequate resources, and uneven access to professional development. The learning environment, particularly outdoor and real-life settings, is an underused but valuable resource for playful mathematics, recognised by key informants and valued by children. Knowing how to use existing resources and environments for playful mathematics learning is an area where teachers need further training and mentoring. Playful approaches also promote inclusion by supporting participation among individuals with diverse learning needs. Finally, effective implementation depends on consistent, practical professional development, which teachers value but report as currently insufficient.

Introduction

The overall aim of this research was to explore teachers' and senior primary school students' views on playful learning in the teaching and learning of mathematics, their understanding of it, the strategies and techniques used in the classroom, and students' experiences of these strategies and techniques. From a theoretical perspective, the overall project aims to build theory related to playful mathematics learning for older children. Building on calls from children for greater opportunities to engage in playful approaches during mathematics lessons (Leavy, Meletiou-Mavrotheris, Paparistodemou & Frischemeier, 2023), this study aims to develop an understanding of the characteristics of playful learning opportunities which support children's development of understanding of mathematical concepts and their enjoyment of engaging in mathematical activities. Drawing on the findings identified in previous research, which highlight challenges teachers experience when implementing new curricula (Devine, Symonds, Sloan, Cahoon, Crean, Farrell, Davies, Blue & Hogan, 2020), this study aims to generate insights to support teachers to utilise playful pedagogical approaches throughout their maths teaching and adapt to implementing the Primary Mathematics Curriculum (NCCA, 2023).

Play as a learning tool has long been valued, with Ellis (1988) inferring that play is central to people flourishing and Hirsh-Pasek, Hadani, Blinkoff & Golinkoff (2020) proclaiming playful learning as a means to support a range of skills. While play is a well-established component of early years education, the latest redeveloped primary mathematics curriculum specifically emphasises the importance of "playful learning" (NCCA, 2023). Yet, despite recognising play as a spectrum from free to guided, our lack of a clear definition regarding playful learning sees ongoing teacher-directed practices (Zosh, Hirsh-Pasek, Hopkins, Jensen, Liu, Neale, Solis & Whitebread, 2018), with some commenting on how play gets hijacked for learning purposes (Goouch, 2008; Hedges, 2022). Playful learning is recognised as active (Zosh et al., 2018), supporting deep and transferable understanding (Yannier, Hudson, Koedinger, Hirsh-Pasek, Golinkoff, Munakata & Brownell, 2021), with Jirout (2020)

intimating that by supporting curiosity, we promote both critical thinking and creative innovation.

Research Aim

An exploration of teachers' and children's perspectives and experiences of effective playful approaches in mathematics lessons in senior primary classes

The objectives of the study are to:

- Gain insights into children's perspectives of what the characteristics of playful learning experiences are in the context of mathematics education in senior primary classes
- Establish what other types of playful experiences, if any, children experience in maths lessons besides 'tables games', board games and games on digital devices
- Gain insights into how playful experiences in mathematics lessons presently are utilised in a way that supports differentiated learning opportunities
- Gain insights into teachers' understandings of what playful approaches in mathematics teaching and learning are
- Identify the extent to which teachers use playful approaches in mathematics lessons with children in senior primary classes
- Generate data about teachers' objectives when they use playful approaches in the teaching of mathematics
- Identify gaps in the resources currently utilised associated with playful learning experiences (e.g. particular curriculum strands, resources for English medium schools, resources for Gaeltacht and Gaelscoil settings)
- Identify specific avenues for further research to advance the effective use of playful pedagogical approaches in the teaching of mathematics to children in senior classes in primary school
- Establish if/how playful approaches generate conceptual and/or procedural understanding, an appreciation of the mathematics topic or a positive attitude towards the topic

Literature review

Many qualities of play enhance our understanding of processes, enabling us to plan and create, our behaviours being both responsive and a catalyst for change (Bergen, 2009). While play is a staple feature in early education, it has only now been considered in relation to older children's learning. The most recent guidelines on the primary mathematics curriculum calls for "playful and engaging learning experiences" (NCCA, 2023, p.11).

Inquiry is often considered the catalyst for children's play (Hirsh-Pasek et al., 2020). This proves interesting as Whitton (2021) proclaims play to have an important role in mathematics, suggesting that mathematical inquiry holds many of the key behaviours observed in meaningful play. Furthermore, as technology forces the world to evolve and we face unanticipated changes (Beig, 2020), teaching must evolve to skills-centred learning, rather than subject-centred learning, focusing on the 4 Cs: creativity; communication; collaboration; and critical thinking (Zakiah and Fajriadi, 2020). Perhaps the 4 C's approach may provide a platform from which to consider how we recognise learning in play, although it is noted with interest that Hirsh-Pasek et al (2020) advocate for a 6 C's approach where they extend beyond the previous 4C's and also include content and confidence.

During the consultation with children which took place during the development of the Primary Mathematics Curriculum, children "universally acknowledged favouring more interactive learning opportunities including the use of real-world contexts, hands-on experiences and playful mathematical experiences such as maths games" (Leavy et al., 2023, p.5). Children expressed a preference for more extensive use of playful approaches that support the development of mathematical understanding (Leavy et al., 2023). Some children felt they learn more when playing maths games using digital devices than completing maths tasks on paper (Leavy et al., 2023). In terms of playful experiences, children supported the use of board games to help them learn mathematics, and valued the fun, ease and interactive nature of the games. Enjoyment of learning through games and of helping other children to learn through games was also identified by children in first class that participated in the Children's School Lives Study. Amongst 5th class children there were

calls for more fun activities (Devine et al., 2020). While some children valued games which involved competition or time restrictions, others sought more opportunities of experiences where there was less emphasis on speed (Leavy et al., 2023).

Teachers of young children that participated in the Children's School Lives research recognised the importance of playful teaching and learning, but they identified few opportunities to engage in professional development to support this (Sloan et al., 2021). Challenges associated with adapting to curriculum change were identified as a key concern of teachers (Devine et al., 2020).

In the two consultations with children to inform the redevelopment of the primary school curriculum, there was strong consensus amongst children that children value playful learning experiences but generally find that these decline with age and do not hold as much opportunity for agentic learning and choice as teachers may perceive. Thus, in the second consultation, Kiely et al. (2024, p.7) noted:

> *Children report they would like more active learning, technology-based and play-based learning, more opportunities to work outdoors and with a partner/peer. Children show a clear preference for playful and active learning methodologies. They appreciate playful teaching, such as games, for subjects they find difficult, particularly in senior classes. Their experiences of the curriculum are clearly influenced by the teaching methodologies used in each subject*

Conceptualising play and playful learning

In 2002, Tamis-LaMonda and Bornstein suggested that an all-encompassing definition of play may prove challenging to articulate. While this remains true, play and its meaning are informed by time, culture and context (Cohen, 2006), the beliefs we hold regarding play and

how we define it risk limiting how we understand play (Fisher, Hirsh-Pasek, Golinkoff & Gryfe, 2008). Perhaps this is the reason we continue to seek the ever-elusive definition of play, yet the very nature of play speaks to flexibility rather than precision (Sutton-Smith, 1997). Indeed, it seems that, beyond the puzzling effort of defining play, we must understand play as a contradiction. Play is childish yet influences so many of our achievements as adults (Gray, 2017), it is situational yet uniform (Larsen, 2015), it requires boundaries while demanding an impulse to cross them (Gordon, 2009). Perhaps it is most aptly described as "a constellation of motives and attitudes, which, taken together, make an activity playful" (Gray, 2017, p219).

While a singular agreed definition remains elusive, to successfully infuse play into the mathematics curriculum, it is necessary to establish a shared understanding of playful learning. Whitton (2021) proffers that play changes with time, place and cultural changes, becoming more complex as we age. Indeed, such is the complexity of play that many researchers conceptualise it as existing along a spectrum, capturing the essence of play while recognising that it "may take different forms and serve many functions' (Zosh, et al., 2018). This notion of play as a spectrum positions free play (Garvey, 1990; Pellegrini, 2009), guided play (Weisberg, Zosh, Hirsh-Pasek & Golinkoff, 2013) and games (Hassinger-Das, Toub, Zosh, Michnick, Hirsh-Pasek & Golinkoff, 2017) and directed play (....) as distinct experiences. Perhaps our best recourse is to "move away from a binary stance regarding play and towards an integration of perspectives and practices, with different types of play perceived as complementary rather than incompatible" (Pyle, DeLuca & Danniels, 2017, p311).

Recent research conducted by the Lego Foundation (2019) suggests that in order to learn through play, play must be: actively engaging; socially interactive; meaningful; joyful; and iterative. In their 2020 research, Hirsh-Pasek et al. also provide key characteristics of playful learning contexts for consideration. They recognise playful learning as an umbrella term for both free and guided play, which fall along a spectrum of play. Here, free play is identified as an activity set up and engaged in by children with no clear learning goal, whereas guided play is initiated by adults and centres around a learning goal, while ensuring children maintain control over their learning.

The role of play within the learning experience is essential for students of all ages, particularly for younger students, as it provides a foundation for the development of executive functions that support higher cognitive thinking skills. Self-regulation can be supported by students developing self-awareness (Shaheen, 2014), which ultimately helps them stay motivated in learning experiences and positively impacts their overall behaviour and achievement (Schunk & Zimmerman, 2012). Impacts of playful learning have been increasingly studied in recent years, with researchers converging towards an agreement that playful learning can lead students to engage meaningfully with learning, help attend to a child's zone of proximal development, and lead to joyful learning experiences that can lead to the development and application of new skills and knowledge (Blinkoff, Golinkoff & Hirsh-Pasek, 2023).

Policy context

Students need to be prepared to live in a complex society that demands 21st-century skills to solve problems, communicate effectively, and collaborate on solutions. Mathematics plays a key role in helping students develop the skills to make sense of the world around them. Unfortunately, mathematics education has often been criticised for being too removed from the challenges and scenarios of the real world (Mosvold, 2008). Furthermore, given the diverse composition of schools it is challenging to provide real world learning opportunities that resonate with all children (Sujatha and Vinayakan, 2023). However, students who develop the belief at a young age that mathematics is helpful to them and can be used in daily life often report enjoying learning and doing mathematics (Mariamah, Ratnah, Katimah, Rahman & Haris, 2021). It is therefore essential that mathematics curricula provide students with opportunities to learn skills that will help them solve real-world mathematical problems, while clearly establishing the value of mathematics.

To provide students with the opportunity to develop these invaluable skills, a redeveloped primary mathematics curriculum (PMC) for all Primary and Special schools was published in 2023. This redeveloped curriculum aims to develop students' mathematical proficiency,

which is conceptualised through five interconnected components: adaptive reasoning, strategic competence, conceptual understanding, procedural fluency, and productive disposition (NCCA, 2023, p. 68). It is essential that, at a young age, children experience mathematics not as a set of rigid routines and procedures, but rather as the wonder and joy it brings. Providing a learning environment that allows all students equitable access to mathematics concepts, playfully and engagingly, is the foundation of the PMC's (NCCA, 2023) learning outcomes. It is expected that teachers provide engaging and playful learning experiences for all students when learning mathematics, increasing the likelihood that they develop a productive disposition towards mathematics and leading students to discover the importance and value of mathematics in their lives now and in the future.

A significant shift from the 1999 mathematics curriculum is an emphasis on creating differentiated learning environments for students. Each classroom is unique, with students with varying learning needs and teachers who approach teaching mathematics in different ways. Therefore, it is expected that the teaching and learning progressions will vary within each classroom and for each student. The 2023 PMC plays a significant role in meeting the diverse needs of students by adopting a learning outcomes approach, which gives teachers substantial professional autonomy to address the needs of each student in their classes. As a result, teachers can make decisions based on student data and professional judgement on teaching and assessing students' mathematics achievement. The 2023 PMC structures the learning outcomes for each of the five learning strands into four learning stages, rather than specifying what students are expected to learn during in each individual year. In addition, progression continua provide suggestions for learning trajectories students may be on. The rationale for structuring the curriculum in this way is grounded in the educational philosophy that each child has a unique set of prior knowledge and beliefs that need to be considered to provide them with a rich mathematics learning experience.

This emphasis on meaningful and responsive learning environments is further supported in recent literature. In their report on *Play, Learning and Teaching in a Redeveloped Primary Curriculum* Ring and O'Sullivan (2025) argue that high-quality primary education should not

be viewed as a choice between play and learning. Rather, they contend that learning is often most effective when it is joyful, meaningful, active and social.

A key theme of the report is the distinction between *play* and *playfulness*. Play is defined as activities that are freely chosen, enjoyable, imaginative, flexible, and child-directed. Playfulness, by contrast, is understood as a disposition or approach to learning that can be incorporated into a wide range of educational experiences, including teacher-led lessons.

This distinction is particularly relevant in the context of the redeveloped Mathematics Curriculum, which emphasises a "playful approach" to teaching and learning. Importantly, this does not exclude explicit instruction; rather, it suggests that direct teaching can coexist with playful pedagogies. This addresses a common concern raised by critics of playful mathematics education, who argue that an emphasis on play may come at the expense of structured teaching and the explicit development of mathematical knowledge and skills.

Playful approaches to mathematics teaching and learning

A growing body of research highlights the powerful role of play-based learning in mathematics education. Integrating playful approaches into maths lessons not only enhances pupils' engagement and achievement (Murtagh, Sawalma, & Martin, 2022) but also provides rich opportunities for children to engage in meaningful maths talk and mathematical reasoning (Thibodeau-Nielsen et al., 2025). Such approaches have been shown to strengthen mathematical fluency (Vita-Barrull et al., 2024) and to nurture more resilient, creative problem solvers (Lai & Cheng, 2023). Furthermore, playful activities capture children's interest, sustain concentration, and improve knowledge retention (Boulahouajeb, Hassine, El Felhi, & Daaif, 2024), making them a highly effective strategy for supporting learning in mathematics.

Playful teaching and learning in mathematics also supports the development of higher-order thinking skills that are essential for 21st century living. Through games and exploratory activities, pupils can develop key cognitive processes such as working memory, inhibitory

control, and self-reflection (Kongthanajindasiri, Sungkaew & Sawangsri, 2025). These skills underpin mathematical thinking and align closely with the aims of contemporary mathematics curricula. For example, the 2023 PMC emphasises the creatinon of learning experiences that connect mathematics to students' everyday lives, enabling them to communicate their thoughts, reason through scenarios, and problem-solve (NCCA, 2023). As a result, young children can obtain the ability to persevere through challenging tasks by utilising self-reflection and regulation abilities that are enhanced during play.

Ultimately, these experiences foster more positive attitudes towards mathematics. By engaging in meaningful and enjoyable learning opportunities, pupils are more likely to develop increased self-efficacy and a more positive disposition towards the subject, supporting long-term engagement and achievement in mathematics.

Research Methodology

The following section describes the research methods employed in this study, including recruitment and sampling procedures, participant characteristics, ethical considerations, and the process of data analysis.

Methods

This research adopted a sequential mixed-methods design consisting of two phases.

Phase One involved the administration of two anonymous online surveys through Microsoft Forms, both of which were available in English and Irish and contained a combination of closed and open-ended questions. The aim of the surveys was to identify participants understanding, perspective, and engagement with playful approaches to mathematics teaching in senior classes

The first survey was distributed to children from Third to Sixth Class attending Irish primary schools, including both English-medium and Irish-medium settings. The survey provided information about the study in both written and video formats and collected demographic information, including class level, school type, and geographical area. Children were then asked about their experiences of learning mathematics through play and their attitudes towards playful approaches to mathematics. The survey took approximately 10–15 minutes to complete.

The second survey was distributed to primary school teachers. Following the information and consent section, participants were asked about their school context, teaching role, class level, teaching experience, and any prior continuing professional development (CPD) related to playful learning. Teachers were then invited to share their views on, and experiences of, playful approaches to mathematics teaching and learning. The survey took approximately 7–10 minutes to complete.

Phase Two built on the findings from the survey data and consisted of qualitative interviews with key informants representing both mainstream and alternative educational approaches.

Drawing on the themes generated in Phase One, the research team developed an interview schedule organised around several key themes: Perception of Play, The Role of Fun in Play, the Place of Play within Mathematics Teaching, Board Games, and Looking Forward. The purpose of the interviews was to explain the theoretical foundation of playful learning in mathematics and to identify best practice approaches to assist in implementing the new mathematics primary school curriculum and the training of teachers.

Recruitment and Sampling

For Phase 1, schools were identified through the National School Annual Census, and alternative schools (e.g., Montessori or Steiner) were added manually. An email was sent out to invite staff to take part in the survey and ask for schools to facilitate participation of pupils. Emails were sent in English to English-medium schools and in Irish to Irish-medium schools. Schools were offered two pathways to facilitate student participation. Pathway 1 envisaged data collection in school, with parental consent being collected prior to this. Pathway 2 was a survey where parental consent was integrated into the survey, allowing schools to send the survey directly to parents, and parents were asked to give informed consent before handing the device to their child to complete the rest of the survey.

Schools received an initial email and two reminder emails. The survey was also promoted on social media, asking schools to keep an eye out for the email.

Phase 2 key informants were identified through relevant organisations and were contacted directly via publicly available contact details or prior connections with the organisation or individuals. Potential participants were provided with information about the study and a consent form and given the choice between an online (Teams) interview or a face-to-face interview.

Participants

Survey data from 67 teachers and 240 pupils were collected. After screening and removing cases where no consent was given, data were available from 64 teachers (E: 36, I: 28), and 209 pupils (E: 159, I: 50). Just 9.2% of the teachers who responded taught in DEIS schools.

The remainder taught in schools that were not designated DEIS status. 47.5% of the children who participated were boys, 55.5% were girls and 2% indicated they would prefer not to say. 20% of children who responded were in 3rd class, 37% were in 4th class, with 26% in 5th class and 17% in 6th class.

A total of 10 key informant interviews were completed. Participants comprised teacher educators, professional learning leaders, classroom teachers, experts in informal mathematics education, and individuals working in curriculum development and evaluation.

Survey Data		
Sample	Raw data	Usable
Teachers (English)	37	36
Teachers (Irish)	30	28
Students (Irish) – in school	12	10
Students (Irish) – via parent	47	40
Students (English) – via parent	181	159

Table 1: Survey Response and Usability Rates

Interview Data
10 x key informants Participants included teacher educators, professional learning leaders, teachers, experts in informal mathematics education, and those working in curriculum development and evaluation.

Table 2: Summary of Interview Data

Ethical Considerations

Ethical considerations were integral to the design and conduct of this study to ensure that the perspectives of both children and adults were represented accurately, respectfully and responsibly. This section outlines the ethical approval process and the measures implemented to maintain ethical standards throughout the research.

An application for ethical approval was prepared and submitted to MIE's Ethics in Research Committee, drawing on MIE and BERA ethical guidelines. The risk and potential to cause discomfort were deemed minimal. Participation was voluntary and the survey was anonymous so there was no undue pressure on participants to take part in the survey. Participants were informed about their right to withdraw up until the survey was submitted. Any data that might identify the individual, their school, or any other personal data was anonymised at the screening stage, prior to analysis.

During the design stage of phase 1, attention was paid to the total time needed to complete the survey. Considering the relevance of the topic to professional practice, the results should be beneficial for teachers' practice and in turn children's learning experiences. Information and consent forms were available in both English and Irish, in accessible language, and participants were given the opportunity to contact the researcher directly to ask questions prior to giving consent.

Participants in Phase 2 were provided with information about the study and gave informed consent prior to being interviewed. Automated transcripts of the interview data were created using Microsoft systems, which were then screened by the research assistant and one member of the research team for accuracy and subsequently anonymised. All raw data was stored in a separate folder, and access was limited to those in the research team involved in screening and anonymising. Anonymised survey and interview data was stored on Teams and shared with the research team. Phase 2 consent form were stored in a separate folder. Everything pertaining to Research Project Administration, the Phase 2 data, and the raw data will be retained for 10 years by the PI and then destroyed. The data from the anonymised questionnaire will be deposited with IQDA in Maynooth or ISSDA in UCD.

Data Analysis

The survey data comprised both quantitative and qualitative responses. Quantitative data were analysed in SPSS, with descriptive statistics employed to summarise participant characteristics and survey outcomes. Qualitative survey responses and interview transcripts were analysed using Reflexive Thematic Analysis (Braun & Clarke, 2006; 2021), following a systematic process of coding and theme development to explore participants' perspectives and experiences.

Key findings

In this section, we present key findings on the conceptualisation and enactment of playful learning of mathematics in upper primary classes, drawing on data from surveys and interviews. The findings indicate a broad agreement on the value of play and playful learning, yet there remains considerable variation in how these concepts are understood and implemented in practice. While teachers often conceptualise playful learning as structured, engaging and requiring specific resources, stakeholder interviews speak to a more nuanced perspective, emphasising child agency and greater integration of playful learning with the curriculum and associated learning outcomes. In addition, findings examine children's perceptions of play, the role of enjoyment in playful learning and the balance of direct instruction and playful methods. Findings further speak to the connection between playful practices and real-world context, the important role of learning environments, including the outdoors, and identifies divergence between teacher and child perspectives. Overall, the findings recognise the potential of playful learning and its ability to support a more inclusive approach to meet the needs of diverse learners.

Key finding #1 Conceptualisations of play in senior primary school

Positive dispositions

Positive dispositions were strongly associated with playful approaches to mathematics by children, teachers and teacher educators alike. Children who indicated that they have experience learning mathematics in a playful way were asked how they feel when learning using this approach. In the vast majority of cases, the responses were overwhelmingly positive (see figure one). Children were facilitated to select multiple responses and to include additional words when their feelings were not fully captured. The most frequently selected response was "happy", with many of the respondents selecting a combination of happy with entertained, excited and in some cases challenged also. In a small number of instances children selected a variety of opposing emotions such as happiness, sadness,

excitement and anger, reflecting the spectrum of emotions they experience. Interviews with key informants also revealed. These are illustrated below. One teacher explained how incorporating playful approaches in their teaching of mathematics “bring about a bit of joy”. In addition, the same teacher highlighted a belief that playful approaches to mathematics help children to learn, particular those who tend to experience nervousness or anxiety “when people are enjoying something, they're more relaxed, and if you're more relaxed, you're more tuned into learning. You don't have to be nervous”.

Other teachers shared a similar view of how playful approaches which are fun can children to consider and explore new mathematical concepts or approaches. “When children are having fun, they're much more relaxed, they're much more open to new ideas”. Comparing the impact of different teaching approaches, teachers highlighted negative experiences associated with some approaches for teaching number facts. “If we were just to sit down and do lots of worksheets or to, you know, kind of drill and kill, if you say it might be effective, but actually you're killing motivation in the long run is what you're doing and you're developing a negative attitude towards mathematics in general”. In contrast, some key informants expressed a view that playful approaches supported the development of children’s confidence and self-esteem in mathematics. A teacher described how some children requiring additional support “had such a negative view of maths and maths learning” and had observed children saying, “I can't do it, I'm stupid at this”. To counteract the negativity, they reporting using equipment like “the poppit squares…. for place value, and all of the sudden they can do wee things. So, I do think it's really important to be as playful as you can”.

A teacher educator shared the view that enjoyment should be central to playful learning activities. They reported working with children and encouraging them to explore mathematical concepts in playful ways “if we do it that way, it encourages kids into the mathematical concepts. It encourages them to explore them. It improves their attitudes towards maths, which again is always positive”.

Figure 1: How Children Feel When Engaging in Playful Mathematics

Spectrum of playful learning

Enacting effective playful pedagogies in senior primary mathematics teaching requires teachers to have a nuanced understanding of what playful teaching and learning is. Yet teachers' conceptualisations of playful learning suggest that work is still needed in developing consensus and confidence regarding its nature in senior classrooms. Key informants who were interviewed after analysis of survey data was completed, however, provide nuanced understandings that can help us to formulate what such effective playful pedagogies might look like, conceptually and empirically in Irish senior primary classrooms where mathematics is concerned.

Interview participants were asked to define play and playful learning, respectively, and held broadly similar views in relation to defining both concepts, with some nuanced differences, especially in relation to playful learning. Participants agreed that children – and adults – engage in play with the purpose of deriving pleasure from it. Play was consistently framed by interviewees as intrinsically motivated, enjoyable and at least to some extent spontaneous and self-directed with interviewees less in agreement regarding the extent to which 'play' on

its own must be self-directed. This general sense of play allows for children's freedom and curiosity and involves exploring, investigating and making choices. In this general type of play, the play engagement or activity does not necessarily have a purpose and does not need to be productive even though it might have a productive element 'by chance'.

In contrast, playful learning is defined by participants as more structured play with a learning orientation. In survey responses, teachers describe playful learning as active, hands-on learning using manipulatives and concrete materials, 'real-life maths', problem-solving and "using relevant games to teach maths while bringing in real life experience" (survey respondent 30) and as a way of making mathematics teaching more fun. As some survey respondents explained

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"Freedom to explore maths manipulatives / presenting maths activities in fun and engaging ways - perhaps with a collaborative or competitive element / not completing maths from board to copy or book to copy - representing maths in different ways -on whiteboards/ tablets/ with concrete materials etc." (Survey respondent 18)

"Giving children the opportunity to learn, demonstrate their knowledge and skills and engage with their Maths learning in a fun but purposeful way." (Survey respondent 14)

"ag foghlaim le hábhair choincréideach le deis comhrá agus fadhbanna a réiteach i ngrúpa." (Survey respondent G13)

The second survey quote emphasises the consideration of giving children ownership or autonomy to explore mathematics through playful activities, bringing attention to the

balance of adult-led and child-led activities in playful learning. A small number of other survey responses echoed this focus on giving children some level of agency, “Giving children space to experiment with finding solutions to problems using tools that they decide may help them” (Survey respondent 8). The majority of survey responses, however, did not touch on child agency or autonomy to this extent and focused primarily on using manipulatives and concrete materials.

Several interview respondents also touched on the balance when emphasising playful learning as “guided discovery” connecting to children’s own interests or curiosities or to “provocations” or topics/problems introduced by the teacher. In the main, teachers’ survey responses suggested primarily adult-led, structure playful activities, while stakeholders who participated in the surveys held more nuanced views on this balance of teacher- vs child-led. As with the definition of play, participants agreed less on the extent to which structure is present in playful learning, ranging from minimal structure, where playful learning emerges organically from a play situation and is thus largely environment-driven to strong structure through guided discovery.

It became clear in some of the responses to what playful learning is that ‘playful’ was interpreted broadly and differently by some participants, with one participant noting that playful could be something as simple as how a topic was introduced – that the tone could be playful or energetic, thus setting a learning activity up for more playful engagement with no actual play being present. Other participants would disagree with this and suggested that playful learning must connect with children’s real-life interests and contexts, connect with their curiosities and involve hands-on learning, thus getting students involved in applying mathematical concepts or problems to practical real-life scenarios relevant to children’s own lives and interests. This understanding reflects the theoretical underpinnings of emergent curriculum, implicitly advocated for in the redeveloped primary school curriculum (NCCA, 2023)

By extension some participations differentiated between playful learning activities, on the one hand, and playful dispositions and mindset on the other, which leads into a focus on exploration and experimentation. Participants emphasised that playful learning can be

understood differently depending on children's age and engagement, denoting the need to untangle our associations and assumptions regarding children's age and playfulness, which we turn to next. Based on participants' interview responses playful learning is perhaps best defined, then, as a pedagogical approach where learning occurs through play-like experiences, combining engagement, curiosity and meaningful learning outcomes, rooted in children's own interests and real-world experiences.

Play across children's age

Interview participants were asked how children's age might figure in teachers' perception and enactment of playful learning in mathematics teaching. There was strong consensus across the interviews that play is crucially important to all children and that the need for play does not decline with age but simply changes form. Yet, while interview participants positioned playful learning and play in its general sense as important throughout the lifespan and for lifelong learning, they also acknowledged that many of their current or former teaching colleagues or teachers they work with through continuous professional development training and other engagements hold 'traditional' views that hold play within educational contexts to be for young children only. Thus, some interviewees suggested that teachers with 'traditional' views question the learning value of play. One interviewee suggested this may come down to not trusting children to engage meaningfully with the playful learning activity and thus expecting children to 'simply' play and not learn from the activity. Interview participants emphasised the importance of having a nuanced understanding of what playful learning actually means, part of which involves understanding how children's play patterns and need for playful engagement change with age. Thus, interview participants positioned play as an emergent curriculum approach that connects with children's own lives and interests, such as playful activities in the outdoors that encourages problem-solving of mathematical tasks connected to children's lived realities.

Balance of direct instruction and playful learning

An important consideration in playful learning is the balance of direct instruction and playful learning activities. There has long been a general perception that learning moves from

exclusively or predominantly play-based in the early years to increasingly centred on formal and direct instruction in the later years of a child's education (Walsh, Taylor, Sproule & McGuinness, 2008). Curricula internationally have tended to follow this spectrum/trajectory; consequently, bringing playful learning more formally and centrally into curricula for the senior end of primary school draws attention to the need to reconsider the balance between play and instruction within senior primary school classrooms.

The relationship between direct instruction and playful learning did not emerge as a prominent theme in the questionnaire data, although it was alluded to in several responses. For example, some participants referred to the importance of teaching concepts explicitly before engaging in playful activities, or to the need to "teach the basics first." Questionnaire Respondent 5 stated that, "Some children need direct, explicit teaching and plenty of reinforcement practice. Playful approaches can complement but shouldn't replace this."

Such responses suggest a somewhat limited understanding of playful pedagogies. As Ring and O'Sullivan (2025) argue in their report of play within the redeveloped primary curriculum, playfulness should be understood as a disposition and approach to learning rather than as an alternative to direct instruction. A playful approach can be incorporated into teacher-led lessons and explicit teaching practices. Consequently, direct instruction and playful learning should not be viewed as competing pedagogical approaches; rather, they can coexist and complement one another within effective mathematics teaching.

This co-existence of instruction and play was a strong message in the interviews with key informants who all held that play is not an effective pedagogy, or indeed a pedagogy at all, if it is simply a fortnightly add on or an intermittent play activity. All key informants positioned playful pedagogy as a mindset that needed to underpin a teacher's approach to teaching and thus underpin all mathematics teaching. As one informant expressed:

"Playful learning to me isn't something you can do once and then scrap it and say, oh, I do playful learning. I do it once every two weeks in my fortnightly plans. That's not what it is. It's not a tick box exercise to me. It's something you need to implement consistently."

Interview participants were asked if all strands of the primary mathematics curriculum can be taught effectively through play and if they believe any areas / strands are not appropriate to teach through playful approaches. Participants expressed that some areas of the mathematics curriculum lend themselves particularly well to playful learning, such as patterns, sequences and space, but did not think there were any areas that could not be taught through playful approaches.

To ensure teaching is both playful and effective, in that children learn what they are required in the curriculum to learn, the majority of key informants interviewed qualified that playful learning opportunities must be planned and appropriately introduced. This preparation for playful mathematics teaching requires some level of direct instruction and introduction of a topic/task and the learning intended in the play activity or engagement.

"I think that if you are going to plan for playful learning as an adult, you need to consider how that learning outcome can be achieved, but you don't take away the children's choice within that activity." (Interviewee 9)

"I do think there's a timing. I don't think you can jump straight out into the playful learning. I think you need to give them a brief. You need to give them the tools to interact with the resources." (Interviewee 8)

There is a fine balancing act, however, in the link between direct instruction to introduce a new mathematical concept and its consolidation through playful learning and using play as tokenistic to conclude the learning process for a new concept. As Interviewee 9 elaborated:

You're getting on to the idea that playful learning is those games that you use as a conclusion activity or just to refresh material that you've already done… I think you can always start to introduce your new context using problem-based learning or learning through problem-solving and within that then you'd have your context from the beginning. That can draw kids in. So while you can introduce your new topic by showing them how to do it and giving them 100 different examples and getting them to repeat that, you're going to lose half the kids along the way or it's not going to be interesting. You're certainly not going to tick that box of children learning through playful learning experiences. So I think that introducing the context at the start and teaching through problem solving is one of the opportunities for using playful learning to introduce new top new topics.

Interviewee 8 described this process as a seesaw between instruction and play, continuously moving between the two when learning, consolidating and revising a new mathematical concept. Central to all key informants' understanding of this pendulum or see-saw motion is the idea that children need to find joy, enjoyment and fun in the learning engagement for which playful pedagogy is the most effective tool.

The role of fun and enjoyment

The theme of fun was prominent in the data. While 45% of children mentioned fun in at least one response, only 23% explicitly referred to it when defining playful mathematics. Among teachers, 36% included fun in their definitions, suggesting somewhat of a shared conceptual understanding. Yet a striking contrast appeared regarding game design: 32% of children who completed the English version of the survey recommended making mathematics games more fun, whereas only a single teacher offered this suggestion. Just 52% of the children who completed the Irish version of the survey provided a definition of playful mathematics. For some, expressing exactly what playful mathematics is proved difficult as captured by their responses "Níl a fhios agam". However, children provided insights into the enjoyment they experienced when learning about mathematical topics, such as measurement, outside. "Tá fad spraíúil nuair atá muid amuigh ag tomhas". References to fun were more prominent

in children's advice for resource developers with advice that games should be more enjoyable and modern "Déan cluichí níos spraiúil agus níos nua aimsire" and children recommended resource-developers to be certain that resources/games were fun. "Dean cinnte go bhfuil sé spraiúil". Among teachers who responded to the Irish-medium version of the survey, references to fun and enjoyment were infrequent. This highlights a notable gap between theory and practice. Teachers recognise fun conceptually, it is notable that children place far greater importance on its practical role in creating engaging mathematical experiences.

Key finding #2 Playful pedagogy and emerging curriculum for maths teaching

Mathematics and real-life examples / learning through the environment/everyday life

Teachers referred to using the environment and real-world life examples in relation to teaching mathematics. For example, on identifying ways in which teachers cited using playful approaches, 17 teachers who responded to the English version of the survey (47%) and 10 teachers who responded to the Irish version of the survey (36%) identified methods relating to real-life examples, with incorporating role-play as the most common (7 out of 17 teachers). Other methods included maths trails, baking, and incorporating manipulatives that are objects children might use in their daily lives.

However, when prompted about whether they use outdoor spaces for teaching mathematics, 23 teachers who responded to the English version (64%) and 23 teachers who responded to the Irish version of the survey (82%) reported using them, such as through math trails, measuring the physical environment, or going on scavenger hunts. These results indicate that teachers may not immediately think of outdoor spaces when reflecting on playful approaches to teaching mathematics, as evidenced by the 17% and 46% differences in responses compared to when they identify ways they use playful learning. This finding is

further supported by teachers' responses to the definition of playful learning, with only 9 teachers (14%) in both Irish and English-medium settings including references to "real-world", "environment" or "timpeallacht" within their self-created definitions. When including terms such as manipulatives or outdoors, this widens the definition of playful learning to connecting to real-world environments to 38%. However, it is essential to point out that manipulatives and outdoor learning can support playful learning but can also give false indications that playful learning is taking place, depending on how the maths lessons are structured. As a result, it is essential for teachers to expand their view of playful learning past what may be defined as "fun" activities, such as board games and role-playing, to include more real-world mathematics learning, which can increase students' productive disposition towards mathematics as they transition to secondary school and is a key component of the 2023 curriculum.

Only 4 teachers across Irish and English medium schools (6%) reported a lack of outdoor space for teaching mathematics through playful approaches, indicating that the physical environment is not a primary barrier to incorporating playful learning in mathematics lessons. Based on this response, it is suggested that teachers do not see real-world connections or the use of the environment as a component of playful learning in mathematics lessons.

Key finding #3 The environment as a resource for playful mathematics learning

Reponses from children, teachers, and key informants highlight the outdoor environment as a space with significant potential for supporting playful mathematics learning in senior primary classes. Despite this strong potential, actual use remains limited. The majority of children (71%) reported that they do not play outside during mathematics lessons with only 19% of children indicating that they do so. A further 10% selected "other", perhaps suggesting more sporadic or less clearly defined experiences of outdoor mathematical play. This points to a notable gap between the recognised gap between the recognised value of

outdoor learning and its consistent implementation in mathematics teaching. Several barriers help explain this low uptake. Structural and organisational challenges within schools were frequently cited, particularly difficulties in accessing outdoor spaces due to timetabling constraints or competing demands for space. One mathematics educator working in informal settings highlighted the broader issue of resistance within school settings:

"The amount of resistance that [the teacher is] meeting in the schools to doing anything that's a bit different, like taking them outside and doing maths trials…it is unbelievable".

Despite these challenges, the experiences of those who do engage in outdoor playful mathematics learning experiences are overwhelmingly positive. All children who had experienced outdoor mathematics reported enjoying it. For some, the simple act of leaving the classroom was highly motivating.

"Outside is fantastic. To get the kids outside, just brings a new energy for most of them… you're just bringing them outside different setting. It takes a little bit longer but there is a new energy for it".

This sense of novelty and increased energy was identified as enhancing engagement and participation.

The outdoor environment was widely recognised as offering rich and immediate contexts for mathematical learning. Key informants emphasised the authenticity of learning experiences outdoors. "I think you can take everything out of the classroom, you know, I mean that that's the reality of it…. I would definitely think it's very important that the students hook into stuff as being from the real world to do with maths straight away. So, there's loads of opportunities". Similarly, the strong connection between outdoor spaces and play was highlighted. "So, I think 100% there are opportunities for outside learning. Isn't that where a

lot of the play goes on for kids?". These perspectives underline the alignment between outdoor learning and the principles of playful, meaningful mathematics.

A wide variety of mathematical activities were described in outdoor contexts by teachers and children. These included practical measurement tasks, such as using metre sticks to measure playground features, as well as data collection activities like counting cards and representing findings in charts. Key informants described some more challenging concepts and skills incorporated into outdoor learning activities, including some which integrated mathematics into games and physical activity: for example, modifying scoring systems in sports to include multiplication, or engaging in physical activities in athletics where children are trying to improve their skill. "You could collect data on it. Again, the maths feels like it's secondary to the activity that they're actually doing".

Outdoor learning also facilitates the exploration of mathematical concepts through the environment itself. Children were encouraged to identify shapes and angles. Activities such as creating "angle museums", mapping coordinates through treasure hunts, and estimating quantities in nature demonstrate the breath of opportunities available. One informant captured this by describing outdoor mathematics opportunities as "infinite".

Importantly, outdoor mathematics can be both structured and flexible. Approaches such as maths trails were frequently discussed, and among key informants the emphasis was on adapting them to be more focused and playful. As one informant described "we'd always have done lots of work on the idea of maths trails, and again, it depends on the activities that you would have at those maths trails, whether it's playful or not". One informant suggested shorted, themed "micro maths trails" can effectively integrate movement and problem-solving without becoming overly procedural. The value of open-ended tasks was also emphasised, with one teacher noting that "if you can put in open-ended questions, that makes it even better".

For some key informants, outdoor mathematics was embedded as a regular and intentional part of the teaching schedule. One teacher described daily outdoor sessions. "We go outside…after break and after lunch for 15 minutes every day". This contrasts with more

occasional uses of outdoor spaces and suggests that routine integration may support more sustained playful engagement.

The findings point to a contrast between the recognised value of outdoor environments for playful mathematics learning and their relatively infrequent use. When utilised, the offer rich, engaging and authentic opportunities that promote integration with other topics, real world connections and playful exploration. Presently a number of barriers need to be addressed in order to support teachers to more fully embed outdoor learning in their mathematics teaching.

Key finding #4 Child and teacher agency

Choice for children

Core to the redeveloped curriculum and its increased focused on playful learning throughout all the stages of the primary curriculum is the emphasis on and prioritisation of child and teacher agency. Within educational contexts, agency is often associated with, and at times reduced to, the notion of choice for children within their learning. Yet choice has been a somewhat contentious concept and does not sufficiently address child agency within the primary school context. Choice is an important aspect of agentic learning, however for agency to be supported children must also feel they can bring their own interests and inquiries to their learning in the classroom (Kiely et al, 2024). In the consultation with children for the redevelopment of the curriculum, it was noted

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There is a need for more agency and autonomy in learning experiences for children of all ages. According to the children, the teacher, principal, the government, the president, subject experts such as archaeologists are in charge and children must do what they are instructed to do. Children's definition of choice may vary significantly from adults. If they are given a

limited array of choices for a specific task, they do not see this as choice.

(Kiely et al, 2024, p6)

In those consultations, it became evident that children do not feel a sense of agency or having choice within their learning, even in the infant classrooms where playful learning was strongly advocated in the 1999 Primary School Curriculum. This finding of children's perceived lack of choice is also reflected strongly in our findings from the survey with children regarding playful learning opportunities in mathematics teaching. Here it emerged strongly that while children acknowledge they experience considerable playful learning, often through games with rules, play in yard, board games and digital games, only a small minority of children felt they had any influence on the playful learning opportunities. Of the 130 children who answered the question "When you play in maths, who decides what you are playing?", it is notable that only 4 (≈3%) children state "I decide". Although a significant number of children (n=37 or ≈28.5%) stated "Teacher and children", it is clear from the below chart that the teacher is very much in charge of the playful learning and children's sense of autonomy or ownership in the playful learning engagement is limited.

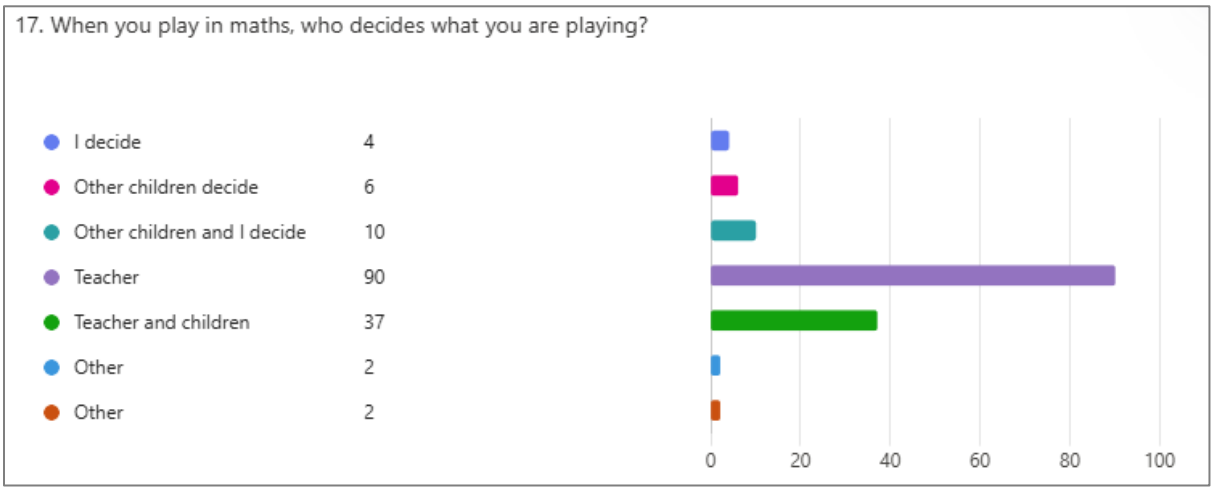

Figure Two: Children's choice in playful maths

The data regarding children's sense of ability to decide in relation to playful learning opportunities are significant. An important nuance is important to note, however. The question specifically related to children's decision-making regarding what they play. Their

answers here are in line with key informants' understanding of playful learning as being structured and planned by the teacher. Key informants noted that it is within the playful learning experience that children have choice and agency, a nuance not captured in the children's survey. Children may therefore lack autonomy and ownership in choosing playful learning opportunities or influencing how and when they are used but they may still be afforded autonomy within such learning experiences. However, it is also important to note here, as discussed elsewhere in this report, that children primary experience playful learning opportunities in mathematics teaching through structured play and games with rules, playful learning that does not hold much opportunity for autonomy or agency, or indeed choice. In other words, if children cannot choose which playful activity and the play activity is heavily structured, opportunities for agentic learning are limited.

Teacher agency

The definition and conceptualisation of teacher agency often differ in the literature, and studies exploring how teacher agency differs from agency have only recently received attention in educational research. This research adopts the understanding of teacher agency from Priestley, Biesta & Robinson (2013), further supported by Cong-Lem (2021), as incorporating the three dimensions of the iterational (background experiences in life and career), the practical-evaluative (beliefs, values, social structures, resources, physical environment), and the projective (short-term and long-term). In combination, these characteristics, which contribute to the level of agency a teacher experiences, were used to analyse the questionnaire and interview data.

Regarding teachers' beliefs and knowledge in implementing playful learning experiences into the mathematics classroom, teachers' experience in studying playful learning in CPD or formal ITE programmes was examined. 44% of teachers have never received CPD on playful learning approaches, with most of the teacher reporting that their exposure in CPD to playful learning was through the 2023 PMC overview days. In relation to practical-evaluative factors, including collective experience and structural considerations, only 28% of all teachers had

the opportunity to learn alongside their colleagues about playful learning in mathematics at their school, indicating a low level of collective agency for implementing and learning about it at individual schools.

The material dimension of agency, regarding resources and the physical environment, was highly referenced within the questionnaire. In relation to challenges teachers faced in implementing playful learning in mathematics, resources were mentioned by 25% of teachers and the need for additional resources to be available to them was identified by 45% of teachers. Time was the number one challenge to playful learning in mathematics. Of the 30 teachers who stated they face challenges in implementing playful learning in maths, 57% indicated time as the primary challenge.

Short-term and long-term (projective dimension) of teacher agency was analysed through the questions regarding continued professional development versus resources. Resources within this research were considered aligned more with a short-term need while CPD indicated teachers may be engaged with incorporating playful learning in mathematics long-term. Salmon (2016) indicates that teachers who consider and create goals with long-term effects to have higher agency. Of the 33 teachers who gave examples of extra supports desired for implementing playful learning in mathematics, only 24% indicated CPD, with the majority desiring resources (45%).

Finally, regarding beliefs in the value of playful learning in mathematics, which relates to the practical-evaluative dimension of teacher agency, 81% rated playful learning as a 4 or 5 on a 5-point Likert scale. No teachers rated playful learning as 1 or 2, indicating that all teachers find playful learning in mathematics at least somewhat valuable.

Key Finding #5 Supporting inclusion through playful approaches

Conversations with key informants revealed a strong recognition of the potential of play and playful approaches to support inclusive pedagogy. As one participant noted, “playful learning by its very nature is quite inclusive, very inclusive.” This statement was exemplified

in insights and examples shared by teachers, teacher-educators, and educators working in informal education settings alike, both relating to Irish medium and English medium education. In Irish medium schools, interviewees emphasised how playful learning creates opportunities for engagement in mathematics where language is more accessible. They draw attention to some of the challenges associated with alternative pedagogical approaches in mathematics education in Gaelscoileanna and Scoileanna Gaeltachta, typically characterised by insufficient resources or inaccessible language within many of the resources available. From a linguistic perspective, a participant noted

"If you are moving towards a more playful approach, exploring, investigating, ... versus them having to read a paragraph in a textbook full of language that they do not understand, it's far more accessible and inclusive"

Having highlighted the difficulty of accessing suitable resources due to language challenges, one participant suggested that playful learning can help overcome this challenge, describing it as "a built-in resource that doesn't need to be translated". Teachers also emphasised that playful approaches could support participation of children across diverse learners. After describing playful activities connected with going on holidays, the interviewee stated:

"The children chose to do that activity and the maths that was going on, everybody could do it irrespective of you know their ability ... you can always give them a calculator, the ones who are struggling with maths, so they can join in as well....there are ways than you can include everybody."

A teacher educator with expertise in designed integrated mathematics and technology identified opportunities for inclusive education using playful approaches when integrating, suggesting that a playful approach "can be a way of making it accessible for some kids". In terms of inclusion the participant spoke of the potential of programming tools that offer learning experiences with "wide walls where you can do a range of different activities or you can include a range of different people's interests in a programme like Scratch, because they can make all sorts of different projects according to their to their needs, so open-ended projects or open-ended technology like that really supports teachers in tailoring things to

kids' interests. One of the things about play and the reason that kids want to play is because it's interesting for them....is great from that point of view because you can make very open-ended tasks with that but still have the mathematical learning outcomes in there".

Interviewees also shared examples of newly arrived children, with limited English, who, through playful engagement, contributed novel strategies to the classroom.

"Within a week [they] had shown me a new way of doing long division... they had a wee dance and a wee song... so they were teaching the class [the new approach]."

This example further illustrates how playful approaches can value and incorporate learners' cultural knowledge. These insights highlight how playful approaches act as a powerful vehicle for inclusion, enabling diverse learners to access, express and contribute to mathematical learning in meaningful ways. In this way, playful learning not only supports engagement but also places learners' experiences as valuable resources within mathematics learning activities.

Key finding #6 Professional development

At the point the survey was administered (Spring 2025), teachers reported varied levels of prior engagement with play and playful learning within their education and profession learning. Less than half of respondents (46%) indicated that they had not studied play during their initial teacher education. A higher proportion (56.9%) reported that they had engaged with play/playful learning through professional development, while 46.2% indicated they had studied Aistear. Specifically, in relation to play and playfulness in mathematics, 38.5% of teachers reported having attended relevant CPD. However, some noted that this input occurred as part of broader professional learning days focused on the Primary Mathematics Curriculum and for some, the did not view playfulness as a focus of the input. Notably, 9.5% of survey respondents indicated they had received no pre-service education or in-service education related to any form of playful learning.

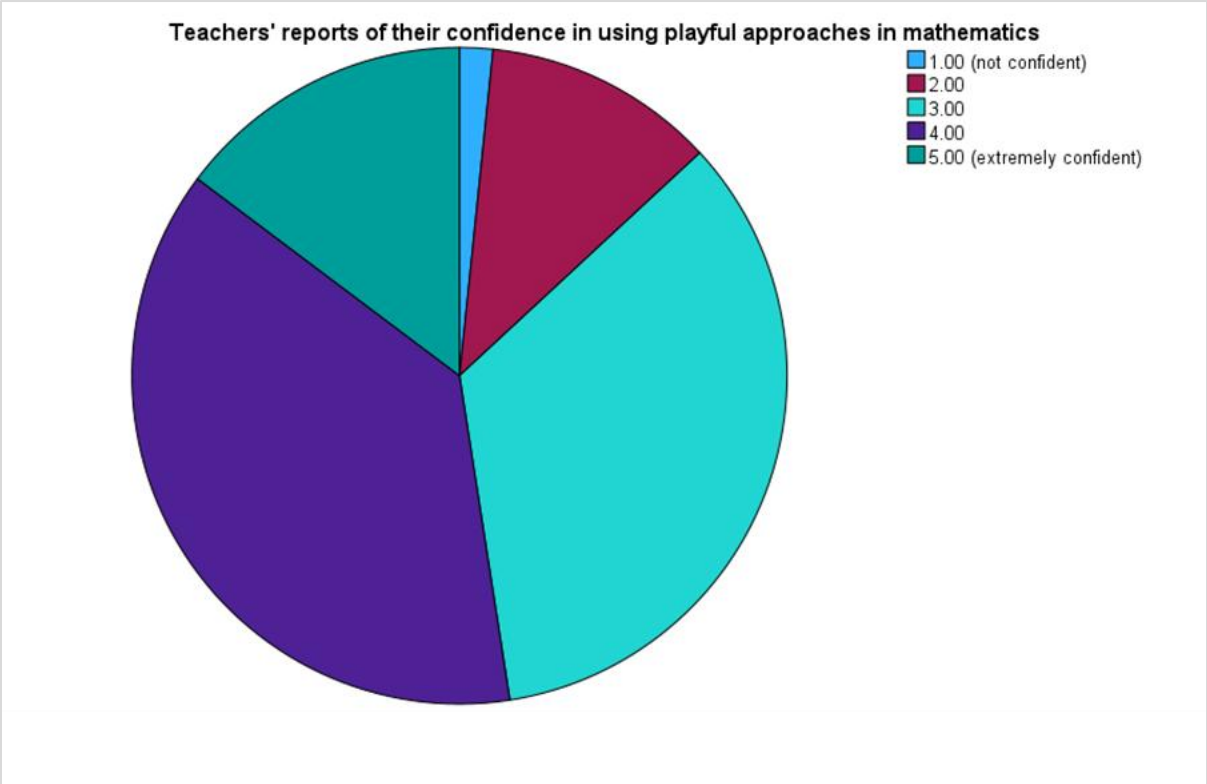

Figure Three: Teachers' confidence in using playful approaches in mathematics

Teacher education was evident within the data as an important factor influencing teachers' use of playful approaches and their confidence in using playful approaches. For example, one teacher attributed their confidence and regular use of playful mathematics teaching to their initial teacher education, stating "I got teacher trained in [North America] and this is just how we teach maths, so I have been confident doing this since I started teaching". In contrast with the insights shared by teachers who studied play during their initial teacher education in other countries, views were shared that there is room for greater emphasis on playful learning in initial teacher education courses in Ireland. One of the key informants who raised this noted "I don't see a lot of playfulness in the teacher training course currently". A belief in the importance of teacher education was also shared by many respondents, where teachers' advice to colleagues who wanted to become skilled in the use of playful approaches in their mathematics teaching was "Déan cúrsa". These insights suggest that

both initial teacher education and ongoing professional learning play important roles in influencing teacher confidence and classroom practice.

Further insights were gained through survey responses, where teachers were asked about supports that would enhance their use of playful approaches. A clear and consistent theme was the need for additional professional development. Teachers called for “more professional learning opportunities” and “further training”, often specifying areas where support would be most beneficial. These included professional learning with a focus on senior classes, supporting children with special educational needs, managing behaviour during playful learning, the use of technology to facilitate playful learning, and using playful approaches to teach mathematics in multi-grade classrooms. For some, the desire for professional learning was linked to a need for reassurance about practice. One teacher reflected their uncertainty, seeking “more ideas and CPD to ensure best practice. I know I am doing a lot but am I doing it correctly?”

A strong emphasis on practice-oriented support and applied learning was also evident. Teachers expressed a preference for opportunities for demonstrations and to see playful mathematics teaching in action. They highlighted the value of observing playful mathematics teaching, accessing examples of playful approaches, and being provided with practical, classroom-ready ideas. Teacher responses highlighted a broader need for collaborative support and professional validation. Beyond acquiring ideas, teachers sought reassurance that their practices were effective. This suggests that professional learning should not only build knowledge but also support confidence through opportunities for reflection and collaboration.

Each of the key informants provided important insights into the importance of professional development. Their views consistently emphasised that effective professional development is essential for the successful use of playful approaches in the teaching of mathematics in senior primary classes and emphasised that professional development must be sustained, collaborative, experiential, and grounded in classroom practice, while also validating

teachers' existing knowledge and supporting their professional judgement. In the view of one key informant, it is imperative that professional development helps teachers to understand that "there is no one way of exhibiting or supporting playful learning". Key informants expressed scepticism that one-off professional learning events would support the type of teacher development required for the successful enactment of the curriculum. One key informant felt that "coming in for a day… I just don't think is going to work". Multiple informants shared insights into how different forms of professional learning, and opportunities for collaborating and sharing were instrumental in their journeys. One key informant credited different forms of professional learning for their expertise including "loads of reading, chatting to other teachers… went into a nursery". Several teachers emphasised that opportunities to share practice were particularly valuable with one noting that hearing colleagues say "this is what I did, and it worked for me" can be highly influential. Collaboration was seen as a means of generating ideas and of collective reflection and improvement, where teachers can "learn from what's happening and have a collaborative discussion around where there are gaps". Informants who enthusiastically described their frequent and successful use of playful approaches in the teaching of mathematics to senior primary classes stressed that professional learning often occurs through informal and peer-based interactions, as well as through more formal engagement with the support services, such as "learning off colleagues…off courses" or through encounters such as "somebody coming in and giving you advice or showing you how to use that". Within-school collaboration was also viewed as critical, with references to "going in and watching someone else" or simply "observing others". Overall, key informants suggested that shared practices are essential for building expertise and confidence particularly when teachers can reflect together on "what worked well or what didn't". Such collaborative approaches were therefore seen as key to sustaining and embedding playful approaches in classroom practice.

Discussion

Findings indicate a significant degree of shared understanding between participants regarding play and playful learning. Both children and teachers framed play as something enjoyable and, to varying extents, something self-directed. However, there exists a tension regarding the degree to which play much be child-led, reflecting the broader discourse around free play versus guided play. Participants noted that play need not have a particular academic purpose, speaking to play as a valuable experience which may sometimes produce learning incidentally. Playful learning, however, speaks to intentionally embedded learning, teachers seeking to harness play in order to support curriculum outcomes. While findings indicate conceptual alignment, there is a noted difference between play and playful learning in practice, with teachers indicating regular use of playful learning which is not so evident in children's lived experiences. This difference may be informed by interpretations of fun and enjoyment. While teachers and children recognised fun and enjoyment as important, children placed greater emphasis on fun and enjoyment for sustained engagement in playful learning. Indeed, a significant number of children wanted increased fun and enjoyment in mathematical learning. This raises the question of how the concept of fun is translated and incorporated into instructional design. This question is central to playful learning as children indicate fun as a requirement for engagement. Factors contributing and compounding difficulties for the enactment of fun and enjoyable playful learning include time constraints, curriculum demands and academic expectations.

Findings indicate that teachers are providing both outdoor and real-life context experiences as a central element of mathematical teaching, highlighting mathematics as embedded in daily life. However, based on responses, teachers do not necessarily recognise these elements within their definition of playful learning. This suggests that playful mathematical practices may exist which are not explicitly framed as such, which may limit intentional use of such techniques as playful learning strategies. This proves particularly interesting as these very opportunities align with children's perception of playful learning, as they naturally lend themselves to enjoyment, autonomy and active engagement, providing the fun children

are seeking as central to their learning. This raises the question of classroom consultation, incorporating children's voices into the design of playful learning experiences to better align playful learning opportunities and expectations.

Implications for research and practice

There is a need to reframe playful learning, distinguishing it from play, so that conceptual understandings may be more effectively translated into playful learning practices. Furthermore, more explicit and intentional use of the outdoor environment and real-world context experiences may strengthen children's experiences of enjoyment and fun in relation to mathematical learning. Classroom consultations are required better align playful learning opportunities with children's expectations and children's perspectives of enjoyment and fun should inform the design of playful learning experiences. Furthermore, the adjustment to playful learning in upper primary classes requires institutional changes. As such, whole-school professional development and collaborative reflection on practices is essential to ensure teachers are confident in having an institutionally shared view of how to enact playful mathematics. Such professional development should seek to support teachers in developing a suite of resources to support them in developing appropriate playful strategies best suited to meet the needs of the children in their classroom. In addition, the development of a framework for assessment of playful learning may enhance teacher self-efficacy in recognising learning as it occurs within play, enabling cross-curricular learning which may better facilitate time management and reduce constraints.

Conclusion

The successful integration of playful learning in upper primary mathematics requires a systemic shift in how play is understood, positioned and assessed within primary education. This report highlights that play must move beyond being viewed as a supplementary strategy, rather, it must be recognised as a central defining component of teaching, learning and assessment. It is necessary to establish a shared and consistent language regarding play

across policy, curriculum and practice in order to succeed in achieving this systemic shift. Furthermore, assessment strategies must evolve to support teachers in capturing the dynamic, process-orientated nature of playful learning, ensuring that engagement, exploration and inquiry, creativity and collaboration are valued alongside traditional measurable outcomes.

Positioning play on a spectrum within the curriculum will support its sustained application into upper primary classes, facilitating an implementation of a broader spectrum of playful approaches. Fun and enjoyment must be positioned as key principles of learning in order to reinforce the innate curiosity of children and their intrinsic motivation to learn. Fostering deeper engagement with mathematical concepts through collaboration and problem-solving. Learning environments must be reconceptualised to ensure the outdoor environment and real-world learning experiences offer meaningful and relatable opportunities for children to connect mathematical concepts with their lived experiences, strengthening both their engagement and their understanding.

Quality learning experiences must be prioritised in practice. Cognitively demanding tasks promote skills such as collaboration and strategic thinking, which are fundamental to meaningful and lasting learning. To this measure, a pedagogical image of children as agentic positions them as co-constructors of learning and their perspectives should be sought through ongoing classroom consultation. Such a shared approach will better align teacher intentions and children's perceptions of playful learning and facilitate more responsive practice which promotes sustained meaningful experiences, in which children are afforded the time necessary for their play to evolve.

Herein, we advocate for recognition of play as a process rather than an outcome. Teachers must be supported, through policy and practice measures, to value time spent allowing learning to emerge through playful engagement, prioritising the learning process over the outcome. Central to this is addressing the tension between time and curriculum demands. To this end, considerations of integrated assessment within playful contexts may facilitate multi-stranded learning, allowing for more efficient instructional time and thus alleviating the time pressure.

The development of a whole-school approach is essential for the consistent and sustainable delivery of playful mathematical learning experiences in upper primary classes. Through collaborative professional development and shared reflection, greater teacher agency and confidence may be achieved which, in turn, will lead to increased responsive and adaptable practice. Beyond self-efficacy, a whole-school unified understanding of playful learning will enable teachers to create, and co-create with children, mathematical experiences which are enriching, enjoyable and provide opportunities for deep and meaningful learning.

In conclusion, a coordinated change to policy, curriculum and practice is required in order to embed playful mathematical learning in upper primary classes. All three areas must present a shared language and collective understanding. Furthermore, assessment must be reimagined to better recognise playful learning as it occurs through meaningful, engaging and enjoyable mathematical experiences to which children relate their lived experience.

Recommendations

Policy

Assessment must evolve to reflect the language of play.

While the conceptualisation of play and playful learning may vary, policy must support a clear and consistent language regarding play which extends beyond learning and becomes central to assessment. Currently, playful learning is difficult to assess in upper primary. The development of an assessment framework which recognises play as central to learning is key in the successful implementation of playful learning in upper primary classes.

Outdoor learning

Outdoor learning should receive greater attention in teacher education policy. Outdoor environments offer rich opportunities to facilitate playful learning and to situate mathematics learning within familiar, relevant real-life contexts. As outdoor environments are easy and free to access for many schools, the use of the outdoor environment needs to feature more strongly in initial and continuing teacher education.

Curriculum

Play to be explicitly positioned on a continuum.

Based on the ambiguity evident regarding how play is conceptualised, it is important that play be recognised by all as a continuum which extends to upper primary school classes. This will facilitate a spectrum of play embedded in curriculum enactment.

Fun to be recognised as a principle of learning.

Given children's desire for fun when learning, fun and enjoyment should be recognised as an explicit principle of effective learning of mathematics. This will facilitate problem-solving, collaboration, and challenge through fun-filled play and enable children to follow their own curiosity and inquiry.

Reconceptualise environmental experiences.

Prioritise real-world learning of mathematics by making use of the broader environment, especially the outdoor environment. Taking a 'maths trails' approach and ensuring real-world learning evolves to represent the lived experiences of children may enhance learning, especially given that children often perceive the outdoors as a playful space.

Practice

Make quality a priority

Playful learning must be supported by meaningful and cognitively challenging games and activities which children perceive as fun. Collaborative problem-solving and games demanding a strategic approach offer rich learning opportunities for children. Child agency and co-construction of games deepen a shared understanding of fun and enjoyment along with ensuring children feel heard.

Classroom consultation

While the new mathematics curriculum was developed with input from stakeholders, children and teachers continue to understand playful learning differently, with children's understanding often being temporally shaped. Ongoing classroom consultation is central to a shared understanding of playful learning and provides opportunity for it to evolve throughout the school year. This may better align what children believe to be of value with approaches prioritised by teachers.

Play as a process

Playful practice must shift thinking regarding task completion. By embedding playful learning, teachers must recognise/must have the professional agency to appreciate the value of process, recognising learning through engagement irrespective of task completion.

The tension between time and tasks

Playful learning will continue to be perceived as an additional strategy used to compliment what is already in place. This limits how teachers use playful learning and the time they

devote to it. A framework to assess skills during play would support teachers in multi-strand assessment; playful learning opportunities naturally cross mathematic strands and integrated lessons result in less time constraints on playful learning.

School community

A whole-school understanding and approach must be established to ensure consistency for children. Through collaboration and shared reflection, teachers will gain confidence in their ability and agency regarding the provision of playful learning opportunities. Shared CPD on-site or via a remote platform could promote teacher's self-efficacy and lead to greater adaptability and responsiveness to children's curiosity.

Centrality of learning outcomes when planning playful approaches

In order to align children's learning experiences with the learning outcomes presented at each stage of the curriculum, teacher supports and professional learning events need to facilitate teachers to plan playful approaches that correspond to the stage of conceptual and skills development of the learners in their context.

Cultures of sharing and structures for sharing need to be developed

Cultures of sharing insights, and structures for sharing manipulatives and playful activities have the potential to overcome some of the barriers to playful use of insights. Sharing insights between primary teachers and access to insights from educators who use playful learning approaches outside of primary have the potential to empower teachers who require information, materials and reassurance in order to effectively utilise playful learning in their teaching. The development of professional learning communities within and between schools is encouraged to support this. The extension of resource-borrowing services within the education-centre network is recommended to facilitate access to manipulatives with potential for playful pedagogy where a lack of financial resources for equipment presents a barrier in schools and where teachers wish to try out equipment before deciding if it is suitable to respond to learning needs within their context.

A central online access point for resource materials is needed

A combination of time-constraints and feelings of being overwhelmed when conducting extensive online searches when seeking examples of relevant, high-quality playful learning activities points to the need for one centralised access point for playful learning support materials. One central online access point where resource developers make materials available is recommended to help alleviate the challenges reported by teachers.

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