Teacher and Pupil Perspectives of Mathematical Self-Perceptions and Enjoyment in two Irish Primary DEIS Schools

Úna Shore

A thesis submitted to the Department of Educational Psychology, Inclusive and Special Education (EPISE),

Mary Immaculate College,

In partial fulfilment of the requirements for the Degree of Doctorate in Educational and Child Psychology (DECPsy)

Supervised by: Dr. Aoife McLoughlin and Dr. Fionnuala Tynan

Word Count for Thesis: 31,915

Submitted to Mary Immaculate College: June 2025

Abstract

Background and Aim: Research in Mathematics has largely focused on older age groups and concepts such as Mathematics anxiety or performance. In 2023, the National Council for Curriculum and Assessment (NCCA) announced a Redeveloped Primary Mathematics Curriculum for schools, which aimed to promote the exploration of mathematics through a lens of playfulness and creativity with a practical application to real-life. The aim of this study was to explore pupil and teacher perspectives of mathematical self-perceptions and enjoyment in younger primary school pupils, in the context of the implementation of the Redeveloped Primary Mathematics Curriculum.

Methodology: The study used an exploratory within-subjects mixed methods design to explore mathematical self-perceptions and Mathematics enjoyment of pupils in first- and second- classes in Irish primary schools. The research was carried out within single class cohorts in two DEIS schools. Pupil perspectives were obtained using the Mosaic Approach (Clarke & Moss, 2011) and responses on the Math and Me survey (Adelson & McCoach, 2011). Teacher perspectives were obtained from an anonymous online questionnaire. The research design was underpinned by the pragmatic research paradigm, and guided by the PERMA framework (Seligman, 2011) and Bronfenbrenner & Morris (2006) PPCT model.

Results: No significant differences were found between first and second class pupils in their levels of enjoyment or self-perceptions. Qualitative findings from pupil Mosaic activities and teacher surveys highlighted the role of play-based and strengths-focused pedagogy in fostering positive mathematical experiences and self-beliefs. Teachers reported increased pupil engagement and confidence, aligned with the redeveloped curriculum’s emphasis on exploratory and experiential learning.

Conclusion: The study explored the research gap by exploring mathematical experiences of pupils in first- and second- classes from a strengths-based perspective. From an educational psychology perspective, the implications of the findings of this study are discussed, with an emphasis on future practice.

Declaration

I hereby declare that this thesis is entirely my own work and has not been submitted for any other awards at Mary Immaculate College or at any other academic establishment. Furthermore, where use has been made of the work of others, it has been fully acknowledged and referenced.

Name: Úna Shore

Signed: Úna Shore

Date: 16 June 2025

Acknowledgements

I would like to sincerely thank my supervisors, Dr. Aoife McLoughlin and Dr. Fionnuala Tynan, for their expert guidance, thoughtful feedback, and continual encouragement throughout this research journey. I am especially grateful for the time, patience, and mentorship they generously provided, which have been invaluable in shaping this thesis and fostering my growth as a researcher. Their dedication has made a profound difference to this piece of work.

I would like to extend my heartfelt thanks to the participating schools, teachers, and pupils. Their cooperation, openness, and enthusiasm greatly contributed to a deeper understanding of pupils' experiences of Mathematics in Irish classrooms. Without their involvement, this study would not have been possible, and I am truly grateful for their valuable contributions.

I would like to sincerely thank the members of the DECPsy team at Mary Immaculate College for their ongoing support and guidance throughout this research. I am also deeply grateful to individuals who have sat on advisory panels, progression panels, and supervisory committees for their helpful insights and constructive feedback, which have greatly contributed to strengthening this thesis.

I would also like to express my deep gratitude to my peers in the DECPsy class. I truly treasure the friendships we have built and the shared experiences that have sustained and encouraged me throughout the past three years. The moral support, encouragement, and companionship, along with the fun and laughs we shared along the way, have been a source of strength and joy during this journey.

I am profoundly grateful to my close circle of friends who have been on this journey with me over the past three years. Their thoughtful check-ins, uplifting words, and steady encouragement have lifted my spirits during the toughest moments and kept me moving forward. Their unwavering support and friendship have meant more to me than I can express.

I am truly thankful to my sisters, Elaine and MaryRose, whose gentle reassurance and countless cups of tea provided comfort when I needed it most. Always ready to listen at the other end of the phone, their belief in me never wavered. Their love and support have been a quiet but powerful force that carried me through the moments of doubt on this journey. *Ní neart go cur le chéile.* I'm truly grateful to my brother-in-law, Conor, for his patience and support, along with his generous help with any technical issues arising throughout this journey. To my dear nephew Ruadhán, your cheerful spirit and countless hugs have been a beacon of comfort and hope during this chapter of my life. Your enduring moral support, even in the smallest moments, has lifted my heart and reminded me of the simple joys along this journey. I am deeply grateful for the joy and warmth you have brought to my life.

I dedicate this thesis to my parents, Philip and the late Sheelagh. From a young age, they nurtured my love of learning and created a home where education was deeply cherished. Their belief that there are no limits to what I can achieve has been my constant inspiration. I am profoundly grateful to Dad for his consistent support and quiet strength throughout this journey. Though Mammy is no longer with us, her warmth, wisdom, and kindness continue to guide and inspire me every day. I am certain her loving presence has been with me every step of the way. *Ní bheidh a leithéid arís ann.*

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Introduction

This first chapter provides the context within which the current study was undertaken. It outlines the research rationale, the researcher's positionality and both the epistemological and theoretical underpinnings of the study. The chapter concludes with a description of the research timeline and overall thesis structure. This study was underpinned by pragmatism and explored teacher and pupil perspectives of mathematical self-perceptions and Mathematics enjoyment. This study was conducted in the context of the recently Redeveloped Mathematics Curriculum (Department of Education (DE), 2023) and explored if differences in mathematical self-perceptions and enjoyment are observed between first- and second- classes in Irish primary school children. The research is funded by the National Educational Psychological Service (NEPS), through the Bursary Award Scheme.

Rationale

Achievement in Mathematics is related to variables like perception of competence (Honicke & Broadbent, 2016, Valentine et al., 2004), self-efficacy (Blessing, 2024), interest (Maamin et al., 2021; Trautwein et al., 2006), and motivation (Rodríguez et al., 2020). It has been suggested that pupils' beliefs regarding their capacity for competence in Mathematics is one of the greatest predictors of Mathematics anxiety and Mathematics performance (Rodríguez et al., 2020; Meece et al., 1990; Ahmed et al., 2012). Pupils who have higher self-efficacy are more likely to engage in Mathematics learning tasks, persevere with mathematical challenges and succeed academically in Mathematics (Hay et al., 2022; Prast et al., 2018; Rodríguez et al., 2020; Zakariya, 2022). Rodríguez et al. (2020) concluded that a more effective way to promote positive academic wellbeing was to increase successful experiences for pupils, which would possibly cultivate perceived competence in pupils who experienced Mathematics anxiety.

While there is much research exploring Mathematics attitudes in pupils, most of this research focuses on Mathematics anxiety, its causes, its impact of on educational outcomes and targeted interventions. Christensen and Knezek (2020) suggest an inverse relationship between Mathematics anxiety and Mathematics confidence and enjoyment. It is noted that, while negative attitudes towards learning may result in resistance to engaging with learning activities and materials, positive attitudes may mitigate such resistance resulting in greater engagement with learning (Duda & Garrett, 2008). Specifically relating to Mathematics, applying these suggestions indicate that negative attitudes could potentially lead to Mathematics anxiety, while positive attitudes to Mathematics may bolster the willingness of pupils to engage.

During middle school (in United States of America), a gap has emerged between boys and girls in Mathematics self-confidence. This "confidence gap" refers to a decline in girls' self-confidence, interest, and ambitions relating to Mathematics, although there is no gender difference in aptitude at this age (Falco et al., 2010). Much of the literature relating to Mathematics confidence has focused on the gender differences in the context of mathematical performance and academic outcomes. Similarly, research in the European context has identified differences between Mathematics confidence of boys and girls, with boys appearing more self-assured in their abilities. While it is common for the confidence gap to be framed in the context of girls exhibiting lower levels of confidence in their abilities compared with boys, it is possible that boys may have inflated perceptions of their mathematical abilities (Cho, 2017; Raabe et al., 2024.) An analysis of Swedish and German samples from the CILS4EU dataset indicated that girls' Mathematics confidence is more aligned with their ability and grades, with boys overestimating their abilities (Raabe et al., 2024). In the Irish context specifically, boys outperformed girls by thirteen score points on the 2022 Programme for International Student Assessment (PISA) (OECD, 2023). Collectively, the gender gap in Mathematics is prevalent in several Western societies, and understanding the mathematical experiences of boys and girls in primary school education is essential to bridging the gap.

Teachers have been included in Mathematics anxiety research, from the perspective of their own experiences of Mathematics anxiety and how this may impact their pupils. Hayes (2016) indicated that many students in third-level education who experience Mathematics anxiety choose to pursue careers in primary school education, while Mata et al. (2022) documented the potential for teachers' confidence in teaching Mathematics to impact their pupils' confidence in learning Mathematics. The manner in which Mathematics is taught in primary schools impacts pupil confidence, enjoyment and attitudes towards Mathematics (Christensen & Knezek, 2020).

In general, Mathematics education research is less common (Pitsia, 2022) than literacy research. In Ireland, the Department of Education (DE) announced the Literacy and Numeracy Strategy in 2011, to boost mathematical achievement among Irish pupils, compared with other nations. In the 2012 PISA, Irish students performed well and ranked 20th out of 65 participating countries, which placed them below other high performing nations such as Finland and Poland (DE, 2013). This indicated areas for potential growth in terms of mathematical success. Identifying any link between self-perceptions and enjoyment in Mathematics and Mathematics confidence would be beneficial in implementing early interventions which could possibly help to develop and maintain Mathematics confidence as children progress through primary school. This could aid in bridging the gender gap as pupils transition into adolescence, which may have an impact on career choice, particularly in the case of girls, as women are often underrepresented in STEM fields (Raabe et al., 2024). In addition to this, augmenting Mathematics confidence would positively impact the child's overall mental health and wellbeing (Colomeischi & Colomeischi, 2023). Given the gaps in Mathematics instruction due to the COVID-19 pandemic, it is possible that children may experience declining confidence regarding Mathematics. With an augmented focus on STEM education, as noted in the Redeveloped Primary Curriculum Framework (DE, 2023) and the ever-growing fields and careers in computer science and technology (Pitsia, 2022), it is essential that children are encouraged and feel confident to engage with Mathematics from a young age.

Recently, the National Council for Curriculum and Assessment (NCCA) announced an updated Mathematics curriculum for primary schools. The Redeveloped Primary Mathematics Curriculum aims to encourage primary school children to explore Mathematics through a lens of creativity and playfulness, aiming to ensure Mathematics learning is relevant to real-life situations (DE, 2023; Koskinen & Pitkäniemi, 2022). The Redeveloped Primary Mathematics Curriculum is aligned with core principles associated with the recent Primary Curriculum Framework, which focuses on developing pupils' Mathematics proficiency in adaptive reasoning, strategic competence, conceptual understanding, procedural fluency and productive disposition (DE, 2023). Additional focus has been placed on mathematical processes such as understanding and connecting; communicating; reasoning and applying; and problem-solving (DE, 2023). This aligns with previous research in the area, which emphasises the positive link between shifting the focus to mathematical reasoning, the process of engaging with Mathematics and long-term mathematical success (Boaler, 2009; Little et al., 2017).

The research questions of both the systematic literature review and the empirical paper, both of which focused on mathematical self-perceptions and enjoyment, were developed in response to theoretical and practical considerations. The study originally intended to examine mathematics anxiety. However, as the research progressed, and in line with a strengths-based and positive psychology approach, the emphasis shifted toward constructs that capture positive engagement and wellbeing in mathematics. The systematic review was shaped to investigate how self-perceptions and enjoyment relate to mathematical outcomes in younger pupils, addressing a gap in existing literature which tends to focus on older children or deficit-based constructs. The empirical study built on these findings, focusing on pupil and teacher perspectives in the context of the redeveloped curriculum. This evolution ensured the research remained relevant to both policy and practice, while also reflecting the researcher's emerging insights and real-world observations in schools.

Researcher's Positionality

I first became interested in Mathematics-related research when I experienced Mathematics anxiety as a pupil in secondary school. I had always succeeded in Mathematics, receiving A grades and enjoyed the challenge of figuring out problems using the appropriate operations. During my Junior Certificate examination, the simultaneous equations question was worded differently, and I couldn't work it out. It was then that I experienced my first panic attack, which would remain through second-level education and continued into third level. I availed of Reasonable Accommodations and had frequent panic attacks. As I began my career as a primary school teacher, I witnessed first-hand the mathematical struggles of children in upper primary classes. As I transitioned to infant classes, I observed an enjoyment and positivity in Mathematics, and I began to wonder where children started to lose the enjoyment and begin to feel anxious about Mathematics. In 2022, I was assigned as a special education teacher (SET) to a first-class cohort (age 7-8 years). I withdrew a small group of children for an hour each day and mirrored what their teacher was doing at a whole-class level, modifying the pace to match their understanding. I observed negative self-talk and self-perceptions relating to Mathematics, with these perceptions often leaving children feeling paralysed with fear, afraid to engage in Mathematics tasks or activities. I observed that when we didn't use the class textbook, they were more willing to engage; therefore, I wondered if the transition from the infant classroom, where a play-based pedagogy is frequently implemented, impacted their ability to enjoy Mathematics, whilst simultaneously causing self-doubt in the form of negative mathematical self-perceptions. The advent of the Redeveloped Primary Mathematics Curriculum (DE, 2023), which promotes more hands-on learning for all classes, has provided an opportunity to gain insights into teacher and pupil perspectives of Mathematics in Irish primary classrooms, in the context of pupil enjoyment of Mathematics and the development of mathematical self-perceptions.

Research Paradigm and Theoretical Underpinnings

The selected paradigm for the proposed research is pragmatism. This has been chosen as pragmatic principles suggest that knowledge is based on evidence gathered by experience of individuals (Brierley, 2017; Allemang et al., 2022). The pragmatic paradigm reinforces the importance and significance of utilising whatever means necessary and relevant to the individual study and research questions, using aspects of both quantitative and qualitative research methods to most accurately and successfully answer the research question (Mertens, 2012). Pragmatism allows for different pathways of engagement with the social world. The proposed research project will use quantitative measures and qualitative information to evaluate the experiences of young children within the school context and explore their self-perceptions and confidence relating to Mathematics. Within mixed-methods research, one of the main principles is that extracting information using both qualitative and quantitative methods can help to bolster the subsequent knowledge and understanding, which is less likely when using either in isolation (Maarouf, 2019). Due to the action-focused nature of pragmatism and its leanings towards solving problems in the real world (Mertens, 2012; Allemang et al., 2022; Brierley, 2017), assumptions underpinning the pragmatic paradigm align with this. These include using the inquiry method and multiple research methods where required, to ensure the most appropriate methods are used to extract relevant data, thus answering the research question (Allemang et al., 2022). As this research uses both quantitative and qualitative methods, and is exploratory in nature, the pragmatic research paradigm was considered appropriate.

There are two theoretical frameworks underpinning the research; the first is Positive Psychology Theory (Seligman, 2000). This theory places an emphasis on identifying an individual's strengths, exploring positive emotions and building the optimal life (Seligman & Csikszentmihalyi, 2000). Positive Psychology Theory will be the lens used to determine how the experience of primary school children relating to Mathematics is explored, in terms of Mathematics confidence, Mathematics enjoyment and self-perceptions. In keeping with Positive Psychology Theory, the PERMA framework (Seligman, 2011) was utilised to structure the thesis. The PERMA framework is grounded in wellbeing theory and focuses on the aspects or characteristics which contribute to an individual's flourishing in their lives. Five elements are included in the PERMA framework (see Figure 1) and are as follows:

1. Positive Emotion

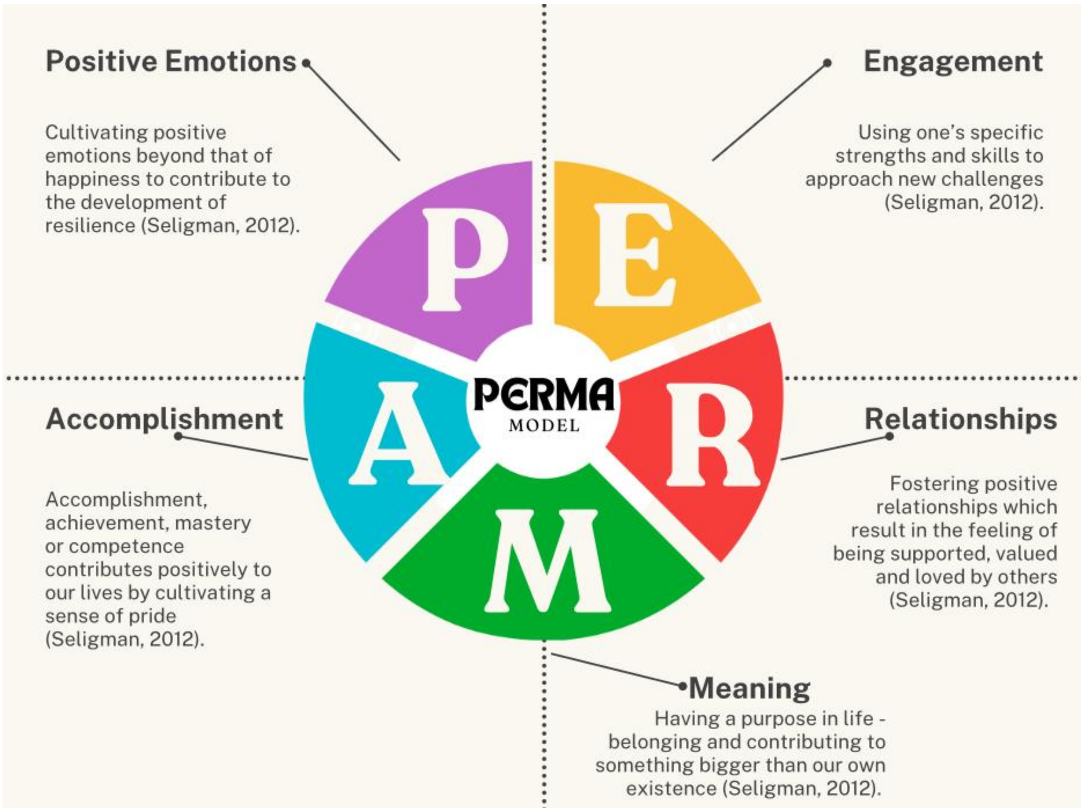
2. Engagement

3. Relationships

4. Meaning

5. Accomplishment

Figure 1.
The PERMA Model (Seligman, 2012)

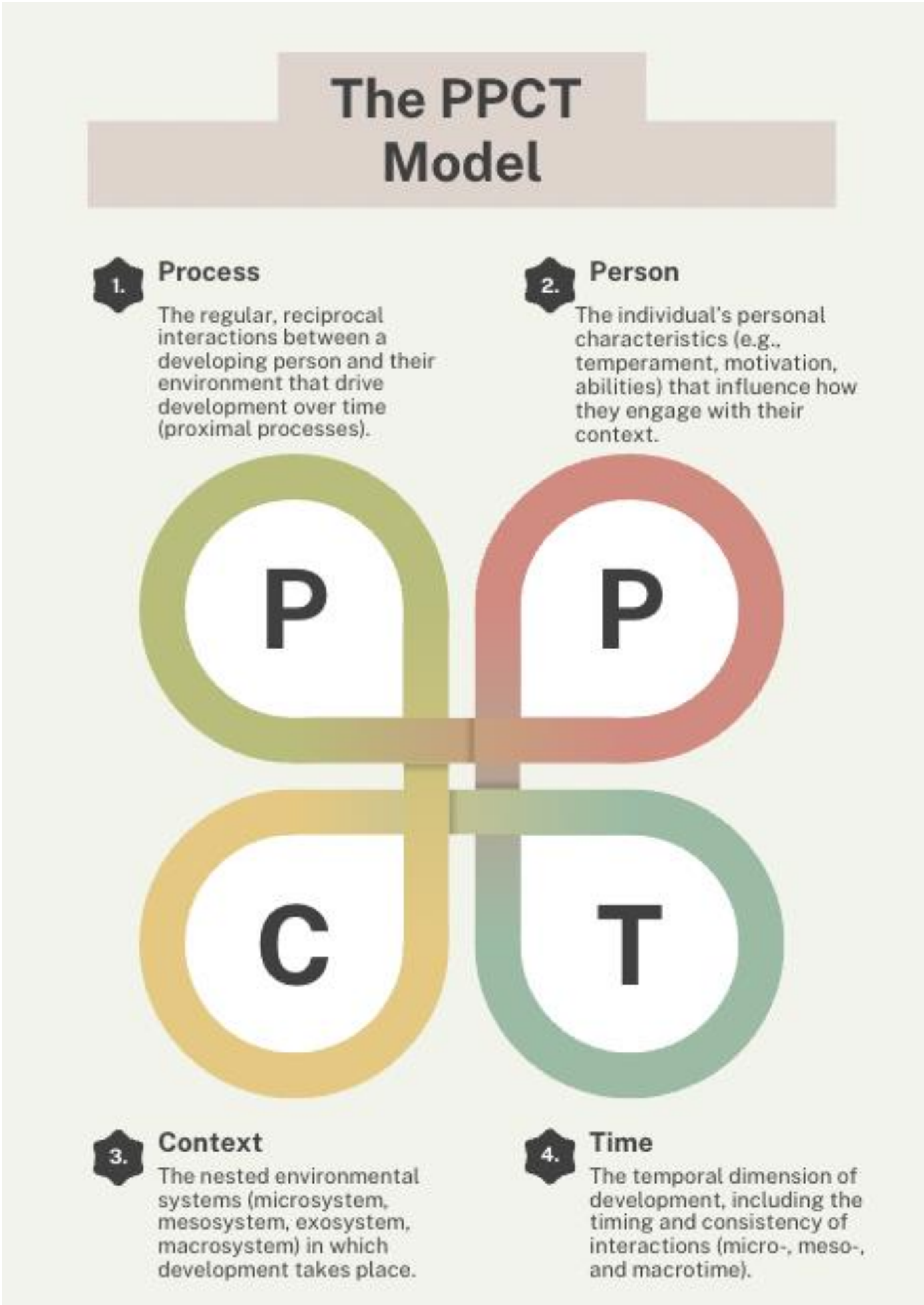


There are strengths and limitations of applying the PERMA framework to educational research with children. Firstly, the framework offers a multi-dimensional approach to conceptualising wellbeing, taking into consideration emotional, cognitive and social factors, which contribute to the identification of factors impacting children's wellbeing (Kern et al., 2015). Additionally, schools who have implemented interventions which targeted the five elements of the PERMA framework, have reported successful outcomes in student engagement and resilience (Turner et al., 2023). The current research was initially focused on exploring Mathematics anxiety, but the study was reframed to reflect positive psychology principles and explore mathematical experiences from this perspective. It is important to also consider the limitations of the framework, such as lack of cultural generalisability, as the five elements of PERMA may not be relevant or considered important in different cultures (Khaw & Kern, 2014). While typically considered relevant in the Irish context, which reflects Western values, Irish society is becoming increasingly more diverse. Furthermore, it can be challenging to measure the elements of the PERMA framework as standardised tools may not fully capture the experiences relevant to wellbeing (Kempf, 2018). Finally, it has been suggested that a focus on positive emotions distorts the conceptualisation of emotions, creating a divide between positive and negative emotions, dismissing the context which is also relevant when considering emotions (Gaffaney & Donaldson, 2025). While the PERMA framework provides a rich lens within which the exploration of wellbeing in educational contexts is facilitated, it is of importance to also remain vigilant regarding the limitations of the model. Positive outcomes for children have been linked to the application of this framework, however continued research and ongoing adaptation may be appropriate to apply the framework to the ever-evolving school context. As the current study is focused on exploring mathematical self-perceptions and enjoyment of pupils, the PERMA framework is suited to exploring Mathematics from a positive psychological perspective.

Bronfenbrenner and Morris' (2006) Bioecological Model of Human Development, which includes the PPCT framework (Process-Person-Context-Time) supports the current study's strengths-based approach to exploring mathematical self-perceptions and enjoyment of pupils in first- and second- classes. Emotional and cognitive development of pupils is impacted by proximal processes which are central to the PPCT model. These processes are defined by the reciprocal interactions between the child and their environment, as sustained over time. The 'Person' dimension includes individual characteristics of pupils, the 'Context' component refers to the environmental systems and the 'Time' element refers to timing of experiences and shifts in policy and practice (see Figure 2).

The focus on self-perceptions and enjoyment aligns with the PERMA model's emphasis on 'Positive Emotion', 'Engagement', and 'Accomplishment', and the PPCT model's recognition of the child's interactions within their learning environment through the proximal processes. These constructs were chosen for their developmental relevance in early education and their importance in shaping pupils' confidence, motivation, and wellbeing in mathematics.

Figure 2.
The PPCT Model (Bronfenbrenner & Morris, 2006)



Research Timeline and Structure of Thesis

The research timeline (Appendix A) portrays the development in the research and depicts when each stage was undertaken and completed. The thesis structure includes three distinct parts: Review Paper (Chapter Two), Empirical Paper (Chapter Three) and Critical Review and Impact Statement (Chapter Four). Chapter Two presents a Systematic Review of the Literature and a Review of Relevant documents commissioned by government agencies such as the Department of Education and the NCCA. Chapter Three details the background and methodology for the study. The thesis concludes with Chapter Four, which outlines the strengths and limitations of the study and implications of the research.

Research Funding

Funding was provided for this research from the National Educational Psychological Service (NEPS) in September 2023, as part of the Bursary Award Scheme which was negotiated by members of faculty at Mary Immaculate College on behalf of Trainee Educational and Child Psychologists in the 2022-2025 cohort.

Conclusion

The introductory chapter has provided the rationale, context and theoretical principles underpinning the current research. Framed by a pragmatic paradigm, and guided by positive psychology (PERMA) and bioecological (PPCT) theories, the study explores mathematical self-perceptions and enjoyment among Irish primary school children through a strengths-based lens. The chapter also outlined the researcher’s positionality and the broader educational context, including the implementation of the Redeveloped Mathematics Curriculum. Following the clear structure and timeline, the study aims to provide a meaningful contribution to the understanding of early experiences in Mathematics.

Policy Context for Mathematics in Ireland

Introduction to the Policy Landscape

The governance of the education system in Ireland is the responsibility of the Department of Education (DE), which includes funding, curriculum priorities and the formulation of national educational policy. The National Council for Curriculum and Assessment (NCCA) operates under the DE and is responsible specifically for curriculum development and review. Collectively, both the DE and NCCA collaborate to ensure education in Ireland aligns with international standards and best practice and is catered to the evolving needs of Irish pupils. There are several documents that have been developed by the DE and the NCCA relating to Mathematics teaching in the primary classroom in Ireland (Table 1). A review and discussion of these documents will provide a clear context for Maths in the Irish context and will indicate the potential contribution of each to fostering enjoyment of maths and promoting positive mathematical self-perceptions in Irish primary school children.

Table 1.
Key Policy Documents Influencing Primary Mathematics Education in Ireland

Policy Document	Publisher/Authority	Year	Focus/Contribution
TIMSS 2023 National Report for Ireland (McHugh et al., 2024)	Educational Research Centre / DE	2023	Benchmarks Ireland's performance in Mathematics and Science internationally; informs curriculum review.
Circular 0039/23 - Primary Mathematics Curriculum	DE	2023	Announces and guides the implementation of the new Primary Mathematics Curriculum.
Consultation Report: Draft Primary Mathematics Curriculum	NCCA	2022	Captures children's voices on Mathematics teaching and learning, highlighting

Policy Document	Publisher/Authority	Year	Focus/Contribution
(Child Perspectives) (Leavy et al., 2023)			engagement and preferences.
Consultation Report: Draft Primary Mathematics Curriculum (Parent & Teacher Views)	NCCA	2022	Reflects stakeholder feedback to shape a responsive and inclusive curriculum.
Reports 17 & 18 (NCCA Commissioned Research)	NCCA	2014	Provide research insights on key areas of Mathematics education reform and best practice.
Audit of Mathematics Curriculum Policy across 12 Jurisdictions (Burke, 2014)	NCCA	2014	International comparisons to inform policy development and innovation in the Irish context.
Aistear: The Early Childhood Curriculum Framework	NCCA / DE	2024	Promotes play-based, child-led learning and serves as a foundational influence for early Mathematics.
Wellbeing Framework for Practice	DE	2019	Emphasises the interconnection between wellbeing and learning, supporting positive attitudes to maths.
DEIS Plan 2017 – Delivering Equality of Opportunity in Schools	DE	2017	Policy framework to address educational disadvantage and narrow

Policy Document	Publisher/Authority	Year	Focus/Contribution
			achievement gaps in DEIS schools.
Looking at DEIS Action Planning for Improvement in Primary and Post-Primary Schools (2022)	DE	2022	Inspectorate report evaluating DEIS action-planning leadership, teaching, learning, and professional development.
Effective literacy and numeracy practices in DEIS schools - Inspectorate Good Practice Guides	DE	2009	Good practice guide outlining effective literacy and numeracy approaches in DEIS schools to improve learning outcomes.
Ireland's National Assessments of Mathematics and English Reading 2021: A focus on achievement in urban DEIS schools (Nelis & Gilleece, 2023)	Educational Research Centre	2023	Analysis of 2021 national assessment data on Mathematics and reading, with a focus on achievement patterns and gaps in urban DEIS schools.

Key Policy Documents in Mathematics Education

Trends in International Mathematics and Science Study (TIMMS) 2023

The TIMMS 2023 National Report for Ireland presents findings about the performance of Irish pupils in 4th class of primary school (age 9-10) and 2nd year of post-primary school (age 13-14), compared with international standards. Irish pupils scored above international average in Mathematics, and one of the strongest within the European Union. The report highlighted scope for development in equity, and enrichment of high-achieving students (McHugh et al., 2024).

Circular 0039/23 - Primary Mathematics Curriculum

Circular 0039/23 outlines the support for the implementation of the Redeveloped Primary Mathematics Curriculum. While Mathematics enjoyment is not explicitly stated, the document promotes engaging, playful and inclusive mathematical experiences. It emphasises creativity, confidence and mastery, highlighting the potential of alternative pedagogical practices to nurture meaningful learning and support the development of positive mathematical self-perceptions in pupils (DE, 2023).

NCCA Consultation Reports on the Draft Primary Mathematics Curriculum

The NCCA's February 2023 report on the Draft Primary Mathematics Curriculum consultation with children aged eight to thirteen highlighted the enjoyment of collaboration and interactive activities, such as Mathematics games and hands-on tasks. While mathematical self-perceptions were not explicitly mentioned, positive emotions linked to success were noted. Educators welcomed the curriculum's aims but raised concerns about its complexity and content volume. Parents prioritised active, practical learning relevant to everyday life and valued support materials that enhance enjoyment. The child-centred curriculum fosters a positive mindset and views each child as a mathematician, emphasising the mathematical process over obtaining correct answers.

NCCA Commissioned Reports 17 and 18, and Curriculum Policy Audit

Report 17. The NCCA's Report 17 (NCCA, 2014) explores Mathematics learning theory for children aged three to eight in Ireland, emphasising mathematical proficiency as the curriculum's central aim. It highlights how 1999 curriculum fostered positive attitudes by focusing on practical applications of Mathematics in daily life, enhancing enjoyment. Children's natural curiosity before formal instruction is noted as a key factor in promoting positive attitudes. Although mathematical self-perceptions are not directly addressed, confidence is recognised as crucial for numeracy and linked to better proficiency. The report also stresses the importance of participation and evolving engagement through repeated exposure to Mathematics tasks.

Report 18. The NCCA's Report 18 (NCCA, 2014) examines how teaching and learning practices influence Mathematics experiences for children aged three to eight in Ireland. It emphasises the value of play in early learning, noting its potential to enhance Mathematics enjoyment when supported by effective pedagogy and adult involvement. The report promotes using children's literature to make abstract concepts relatable, boosting engagement and enjoyment. It also supports project-based learning, where enjoyment is central, and recognises sensory enjoyment as a key curricular aim. While mathematical self-perceptions are not directly addressed, the report explores parental self-confidence, its impact on children's Mathematics, and suggests strategies to support parental involvement.

Curriculum Policy Audit. The NCCA's international audit of Mathematics curriculum policy, conducted prior to revising the 1999 Primary School Mathematics Curriculum, assessed how the Irish curriculum compared globally (Burke, 2014). While the structure aligned broadly with international curricula, gaps were noted in curriculum supports and the specificity of learning outcomes. Flexibility in pupil progression and reduced emphasis on age-related attainment were highlighted. The report focused on enhancing pupil achievement through external supports, resources, and assessment. However, affective dimensions such as emotions and attitudes towards Mathematics received limited attention. Although mathematical self-perceptions were not addressed, the report promoted innovation and referenced alignment with the Aistear framework.

The Wellbeing Framework for Practice and its Relevance to Mathematics

The Wellbeing Framework for Practice, published in 2018 and revised in 2019 (DE, 2019), supports schools in promoting wellbeing through self-evaluation and planning. It outlines four key areas for development: Culture and Environment, Curriculum, Policy and Planning, and Relationships and Partnerships. Though not specific to Mathematics, it aims to enhance wellbeing in schools. Enjoyment is emphasised as essential, with a guideline stating that learners' enjoyment is linked to progress, achievement, and motivation. While mathematical self-perceptions are not addressed, the framework highlights self-efficacy as a key factor in wellbeing promotion, recognising its relevance within the school context.

Key Policy Documents Relevant to DEIS schools

DEIS Plan 2017-Delivering Equality of Opportunity in Schools

The DEIS Plan 2017 sets out a national framework for addressing educational disadvantage in Irish schools through targeted supports and interventions. It highlights the importance of improving literacy and numeracy outcomes, with Mathematics recognised as a key area for monitoring pupil progress. The plan promotes the use of data-informed, evidence-based approaches, encouraging schools to foster high expectations and positive attitudes toward learning. Although self-efficacy and enjoyment are not explicitly named, the plan foregrounds the importance of student engagement, motivation, and wellbeing, all of which are known to support mathematical confidence and positive self-perceptions. The plan also emphasises the Home School Community Liaison (HSCL) and School Completion Programme (SCP) as mechanisms to build inclusive, learner-centred environments that value pupils' experiences. The importance of teacher professional development is underscored, with a focus on raising expectations and supporting effective pedagogy and interventions, including in numeracy, which is closely linked to children's beliefs in their capabilities. In 2022, the DEIS programme was reviewed, updated, and expanded using a refined data-based model to include more schools and children in communities at risk of educational disadvantage, promoting equity in learning experiences, including numeracy outcomes.

Looking at DEIS Action Planning for Improvement in Primary and Post-Primary Schools (2022)

This document provides a structured framework to support DEIS schools in setting and reviewing focused targets across the DEIS themes, particularly numeracy. It promotes the use of the School Self-Evaluation (SSE) six-step process to identify strengths, set clear improvement goals, and implement evidence-informed interventions that are tailored to the individual school context. While the concepts of mathematical self-efficacy and enjoyment are not named directly, the guidance emphasises the importance of student voice and engagement, factors which could lead to the development of positive mathematical self-perceptions. The document encourages schools to adopt an inclusive approach that recognises the potential of all learners, particularly those at risk of underachievement. It supports the development of high expectations, effective differentiated teaching strategies, and targeted support in Mathematics (Maths Recovery), all of which can contribute to greater pupil confidence and enjoyment. The iterative action planning process, underpinned by SSE, helps schools to reflect on the impact of their strategies and adapt them to meet learners' needs, which could promote sustained mathematical engagement and growth over time.

Effective literacy and numeracy practices in DEIS schools -Inspectorate Good Practice

This good practice guide, developed by the Department of Education Inspectorate, outlines effective approaches to improving literacy and numeracy outcomes in DEIS schools. Drawing on evidence from evaluations, it highlights practices that support high-quality teaching and learning, particularly in schools serving disadvantaged communities. One of the main changes for pupils reported in the document referenced enjoyment, stating that they have fun, express enthusiasm and engage more in Mathematics lessons, displaying enjoyment whilst engaging in problem-solving with their peers. The guide notes that effective DEIS schools create supportive, inclusive learning environments where success is celebrated, and pupils are encouraged to take risks in their learning. Such environments can enhance pupils' sense of competence in Mathematics and contribute to greater enjoyment. It also highlights the importance of early intervention, target setting using the process of action planning, and ongoing assessment for learning, which help teachers to personalise learning and build on pupils' strengths. Strong school leadership, collaborative planning, and the use of data to inform practice are also identified as key enablers of success in numeracy, helping to reinforce high expectations and nurture positive attitudes towards Mathematics.

Ireland's National Assessments of Mathematics and English Reading 2021: A focus on achievement in urban DEIS schools (Nelis & Gilleece, 2023)

This report analyses the performance of pupils in urban DEIS schools in the 2021 national assessments. It reveals that mathematics achievement at 6th class level has remained broadly similar since 2014, with only limited evidence of narrowing achievement gaps between school types, suggesting that progress towards DEIS targets has been modest. Findings highlight the importance of sustained, evidence-based teaching approaches, especially in DEIS Band 1 schools where achievement gaps persist. Additionally, the findings imply that sustained support, such as the use of formative assessment, targeted interventions, and ongoing teacher CPD, remain crucial for addressing persistent achievement gaps in DEIS Band 1 schools, and may indirectly foster pupils' self-perceptions and enjoyment relating to Mathematics.

Summary of Policy Implications for Mathematics Enjoyment and Self-Perception

To conclude, the studies previously mentioned highlight the significance of cultivating a positive and engaging approach to the teaching of Mathematics in primary schools. Enjoyment and enthusiasm Mathematics are explored in various ways and are essential in supporting children to develop mathematical self-perceptions that support both academic success and wellbeing in general. The reports accentuate the need for a curriculum that aims to balance the cognitive with the affective, enhancing mathematical understanding and fostering a child's innate curiosity and confidence in Mathematics. Considering the perspectives of key stakeholders such as children, parents and teachers, underpinned by the Wellbeing Framework for Practice, developing an inclusive and engaging context for optimal teaching and learning Mathematics is essential. DEIS-related policies further reinforce this by emphasising equity, engagement, and evidence-informed strategies in numeracy, supporting the development of confidence and positive attitudes in schools serving disadvantaged communities. In approaching the teaching and learning of Mathematics in this manner, the development of mathematical skills in conjunction with a positive attitude towards the subject is essential in assisting children on their journey as lifelong learners.

Systematic Literature Review

Introduction

Mathematics Education in Primary School

It has been suggested that the primary goal of Mathematics education is to enable pupils to cultivate the knowledge and skills that they will need in their professional and personal development (Kaskens et al., 2020). This indicates the necessity for curricula to be accessible to pupils, cultivating positive experiences and instilling self-beliefs from a young age. Children are susceptible to the beliefs and attitudes of those around them, which can shape the attitudes that they develop themselves. This aligns with Bronfenbrenner and Morris' (2006) Bioecological Model of Human Development, which emphasises the dynamic interaction between a child and their environment over time. Proximal processes are most significant in the microsystem, such as the home environment and the classroom context, where the developing child is exposed to the attitudes and perceptions of teachers, parents and peers. Educational institutions often attempt to improve pupils' Mathematics achievement by implementing innovations such as gamification (Chen et al. 2020), Realistic Mathematics Education (Juandi et al., 2022) and enhancing motivation (Stroet et al., 2016). An important consideration, when attempting to improve mathematical success for pupils, is promoting meaningful learning (van Rijk et al., 2017). Whilst the classroom environment, curriculum and teaching methods are important, some pupils face challenges relating to Mathematics which can hinder opportunities to achieve their potential.

Challenges Facing Pupils relating to Mathematics

Mazzocco (2007) suggests that Mathematics is perceived as difficult for some pupils due to lower self-esteem relating to Mathematics and differences in adequate Mathematics instruction. This indicates the salience of bolstering self-perceptions and Mathematics enjoyment, to foster an ableist mentality among primary school pupils. It has been suggested that pupil self-efficacy, self-concept and anxiety relating to Mathematics contribute to perceiving Mathematics as challenging and have been linked with Mathematics performance (Kaskens et al., 2020). The impact of these constructs on

Mathematics performance and attainment indicates the need for exploration of pupils' experience, and their attitudes towards Mathematics.

Mathematics anxiety (MA) is a challenge faced by some primary school pupils. It is characterised by feelings of inadequacy and fear relating to Mathematics-specific situations (Hembree,1990). This feeling elicits a negative emotional response in an individual, and is not specific to current situations, but can also be at the prospect of enduring a situation relating to Mathematics (Hill et al., 2016). MA can have inhibiting effects on the educational trajectory of pupils (Beilock & Maloney, 2015). Pupils who experience MA are more likely to exhibit decreased confidence relating to Mathematics and avoidant behaviours when faced with Mathematics tasks or activities (Maloney & Beilock, 2012). Given the link between pupils' attitudes and their engagement and success in Mathematics, it is important to explore pupils' mathematical self-perceptions and enjoyment. Understanding these attitudes may help identify ways to foster more positive experiences of Mathematics, which in turn could support pupils' confidence, motivation, and achievement.

Mathematics Attitudes

It has been suggested that Mathematics attitudes can be altered (Singh et al., 2002), which indicates potential for improving Mathematics achievement. Chen et al. (2018) identified a significant link between Mathematics attitudes and Mathematics achievement. They accounted for age of participants, IQ, working memory and experienced MA of participants, which decreased the possibility that Mathematics achievement was attributable to other variables. Longitudinal studies have indicated that Mathematics attitudes have the potential to improve Mathematics skill development over time. Bodovski and Farkas (2007) found that positive Mathematics attitudes resulted in improved mathematical outcomes between kindergarten and third grade. Harackiewicz et al. (2016) propose that cultivating interest in a subject or topic among pupils may engage and motivate pupils. This is probably applicable to Mathematics learning, as children who enjoy Mathematics-related tasks and maintain positive attitudes towards Mathematics are more likely to remain motivated and engaged, particularly when confronted with more challenging activities (Chen et al. 2018). Children who experience higher self-efficacy and display enjoyment in Mathematics possess a greater chance of experiencing positive outcomes relating to Mathematics including increased focus, active engagement and perseverance in the face of challenging mathematical tasks (Stipek, 2002). Therefore, exploring Mathematics attitudes is of importance, as it provides a distinct opportunity to improve the prospect of cultivating positive Mathematics-related outcomes in pupils.

Mathematical Self-Perceptions

A core aspect of attitudes towards Mathematics is mathematical self-perception of ability, which refers to one's belief regarding how capable one is at Mathematics (Montague & van Garderen, 2003). It is a crucial element of attitudes towards Mathematics, as it can have an impact on how they approach future tasks and the effort they exert (Montague & Van Garderen, 2003). It is possible that children who have more positive mathematical self-perceptions have more positive mathematical experiences in general and may approach Mathematics challenges with a belief in their ability to overcome challenges, thus increasing their perseverance with more difficult tasks. Pupils who possess the self-belief that they can achieve academic success are more likely to perform better (Ruijia et al., 2022). Dowker et al. (2019) have suggested that mathematical self-perceptions are linked to both Mathematics performance and improvements in Mathematics skills. This indicates the salience of cultivating positive mathematical self-perceptions in pupils, with the possibility of enhancing their skills and attainment. A direct correlation between more positive mathematical self-perception and sustained improvements have been found in longitudinal studies (Peterson & Hyde, 2017; Trautwein et al., 2009; Wigfield & Eccles, 2000). This indicates that exploring ways to instil positive mathematical self-perceptions in pupils could be beneficial, especially at a young age. Additionally, pupils who hold negative mathematical self-perceptions do not perform as well on assessments (Watt et al., 2012), indicating that there may be a predictive element to mathematical self-perceptions. Whilst mathematical self-perceptions are thought to impact Mathematics attitudes and subsequently Mathematics performance of pupils, they are not fixed and are amenable to change over time. This is substantiated by Peterson & Hyde (2015) who suggest that pupils who experience low self-perceptions can achieve better than expected outcomes on assessments if their self-perceptions alter over time. This emphasises the importance of cultivating positive mathematical self-perceptions in pupils. Another aspect associated with attitudes towards Mathematics is the enjoyment pupils associate with engaging in Mathematics-related tasks and activities.

Enjoyment of Mathematics

It is possible that children who find Mathematics tasks and activities pleasurable have more positive attitudes towards Mathematics and are more willing to persevere with challenging tasks. An interest in Mathematics or liking Mathematics is related to children's improvements in Mathematics (Aunola et al., 2006). The same study suggested that higher improvement in Mathematics was associated with increased levels of liking Mathematics over time. This indicates that there is a bidirectional relationship between Mathematics enjoyment and Mathematics performance. Enjoyment has also been conceptualised as a potential barrier to pupil perseverance and success in developing and utilising mathematical reasoning skills (Barnes, 2021). When pupils become consumed with creating an abundance of solutions, whether relevant or not to solving the task, paying little heed to their teachers' prompts, the enjoyment of generating large amounts of potential solutions inhibits their ability to adapt and change their processes and utilise their mathematical reasoning skills (Barnes, 2021). The same study found that some pupils can become unaware of their struggles relating to Mathematics as they focus on affective responses such as excitement and enjoyment, masking their challenges which can mislead their teachers, who witness the external affective expression, missing the potential challenges (Barnes, 2021). Mathematics enjoyment has the potential to impact their cognitive or behavioural engagement with the subject (Syyeda, 2016). Children who have experienced success relating to Mathematics are more likely to engage in challenges that are problem-based, which boosts their overall learning experience (Mazana et al., 2019). Thus, enjoyment of Mathematics has the potential to improve outcomes for pupils, however if enjoyment of Mathematics prevents children from engaging in self-regulation and acknowledging difficulties, it has the propensity to impede progress, and impact mathematical performance. This is of particular relevance given that the DE (2021) emphasised the need to improve learners' enjoyment of Mathematics, with specific reference to DEIS schools, in an effort to enhance engagement and outcomes for pupils in Mathematics.

Mathematical Performance

Mathematics performance can be interpreted as the success or attainment achieved by a pupil in Mathematics. Several factors impact the potential for students to perform well in Mathematics, which include teaching quality and methodologies (Atlay et al., 2019), environment (Taylor & Fraser, 2013) and pupil attitudes towards Mathematics (Mazana et al., 2019). Of these, pupil attitudes towards Mathematics are considered to have the greatest impact on pupils' Mathematics achievement (Mata et al., 2021).

There are several factors which contribute to the completion of mathematical operations, necessary for mathematical success, such as cognitive and emotional abilities (Dowker et al., 2012). The emotional experiences of pupils play a pivotal role in their development and both their current and potential achievement (Mata et al., 2021). Emotions relating to pupils' learning and performance are labelled "achievement emotions." It has been suggested that poor performance in Mathematics can lead to the development of MA (Dowker et al., 2012). This highlights the salience of exploring the emotional experiences of pupils relating to Mathematics, as it allows for greater understanding of the degree to which emotional experiences influence mathematical success over time.

The quality of pupil-teacher relationships is a key environmental factor that has the propensity to impact both wellbeing and mathematical performance. Relationships that are supportive and responsive in nature can cultivate motivation and perseverance when faced with academic challenges (Roorda et al., 2017). Considering this in the context of Bronfenbrenner and Morris (2006) Bioecological Model of Human Development, proximal processes are essential in facilitating children's learning and development. Teachers who play a pivotal role in the development of pupils' competence beliefs and attitudes relating to learning, feature prominently in the microsystem.

From a developmental perspective, Erikson's psychological stage of Industry vs. Inferiority can be applied to these essential interactions in middle childhood. During this stage, children are motivated to achieve academic success and competence through mastery and validation. When teachers create nurturing classroom environments, underpinned by tailored support and attention this can contribute to a sense of industry, whilst children who experience challenges in academic tasks or feel unsupported in the classroom context may develop feelings of inferiority or disengagement. In the context of Mathematics, where challenges and self-doubt can be particularly pronounced, fostering positive teacher-pupil relationships and a supportive classroom environment is essential to promote confidence, resilience, and a sense of competence among learners.

Rationale and Research Objectives

This review is focused on investigating the propensity for mathematical self-perceptions and enjoyment of Mathematics to impact overall engagement and outcomes of primary-school children. Considering the potential for positive mathematical experiences to encourage children to pursue careers relating to Mathematics, and the ever-growing field of STEM, it is important to explore the role of mathematical self-perceptions and enjoyment of Mathematics in fostering these positive mathematical experiences. In addition, it is imperative to consider the absence of positive mathematical experiences and the impact this may have on children's self-perceptions and enjoyment of Mathematics. The decision to focus the review on enjoyment and self-perceptions, rather than anxiety or motivation, reflects a deliberate strengths-based shift in the research study, which was influenced by early findings in the literature and a purposeful alignment with the Redeveloped curriculum's emphasis on positive pupil experiences. Thus, the purpose of the current review is to explore the impact of self-perceptions and enjoyment relating to Mathematics in primary school children.

Therefore, the question to be addressed is:

Do mathematical self-perceptions and enjoyment of Mathematics contribute to more positive outcomes in attainment of primary school pupils?

Methodology

Systematic Review

Systematic reviews are generally accepted as having the capacity to overcome challenges posed by literature, such as lacking adequate rigour (Bower, 2010) and therefore being subjected to bias during the review process. Hanley & Cutts (2013) propose that potential biases include confirmation bias and only including studies of which one is aware. The Cochrane Handbook for Systematic Reviews of Interventions (Chandler et al., 2019) suggests guidelines and parameters within which systematic reviews should be conducted which were adopted for the current study.

Search Strategy

An in-depth literature search was conducted in September 2024, using the following databases: PsychInfo, ERIC and Google Scholar. Exploring Mathematics enjoyment and mathematical self-perceptions from both an educational and psychological perspective was necessary to ensure all possible articles were included in the review, which is why both PsychInfo and ERIC were utilised. Google Scholar was used to conduct a hand search of articles that may not have been included on these databases. Search Terms presented in Table 2 were used in the search procedure, which is reflected in the PRISMA diagram (Figure 3).

Table 2.
Search Terms for Database

		Sample		Outcome
Math* Self-Perception OR Math* Enjoyment	AND	primary OR elementary AND pupil* OR student* OR child* OR learner AND teacher*	AND	Math* success OR math* performance OR math* attainment OR change in math* experience

Note. Filters were applied to limit the search to publications in the English language, and articles from the years 1999-2024.

Articles published between 1999 and 2024 were included, as 1999 was the last time that the Irish Primary Mathematics Curriculum was updated, prior to 2023. This resulted in the identification of 699 articles. Several filters were then applied, including limiting consideration only to peer-reviewed journal articles, empirical studies and those studies with an educational psychology focus. This resulted in the identification of 253 articles. A hand search was then conducted, and a further 9 articles were identified. All 262 articles were screened by title and abstract, with inclusion and exclusion criteria depicted in Table 3 applied. This resulted in the exclusion of 190 articles. The full texts of the remaining 72 articles were screened for eligibility purposes. Following this screening, nine articles remained. Table 4 displays a list of included articles, and the search strategy is displayed in the PRISMA diagram in Figure 3.

Figure 3.

PRISMA Flow Diagram Demonstrating Search Strategy (Moher et al., 2009)

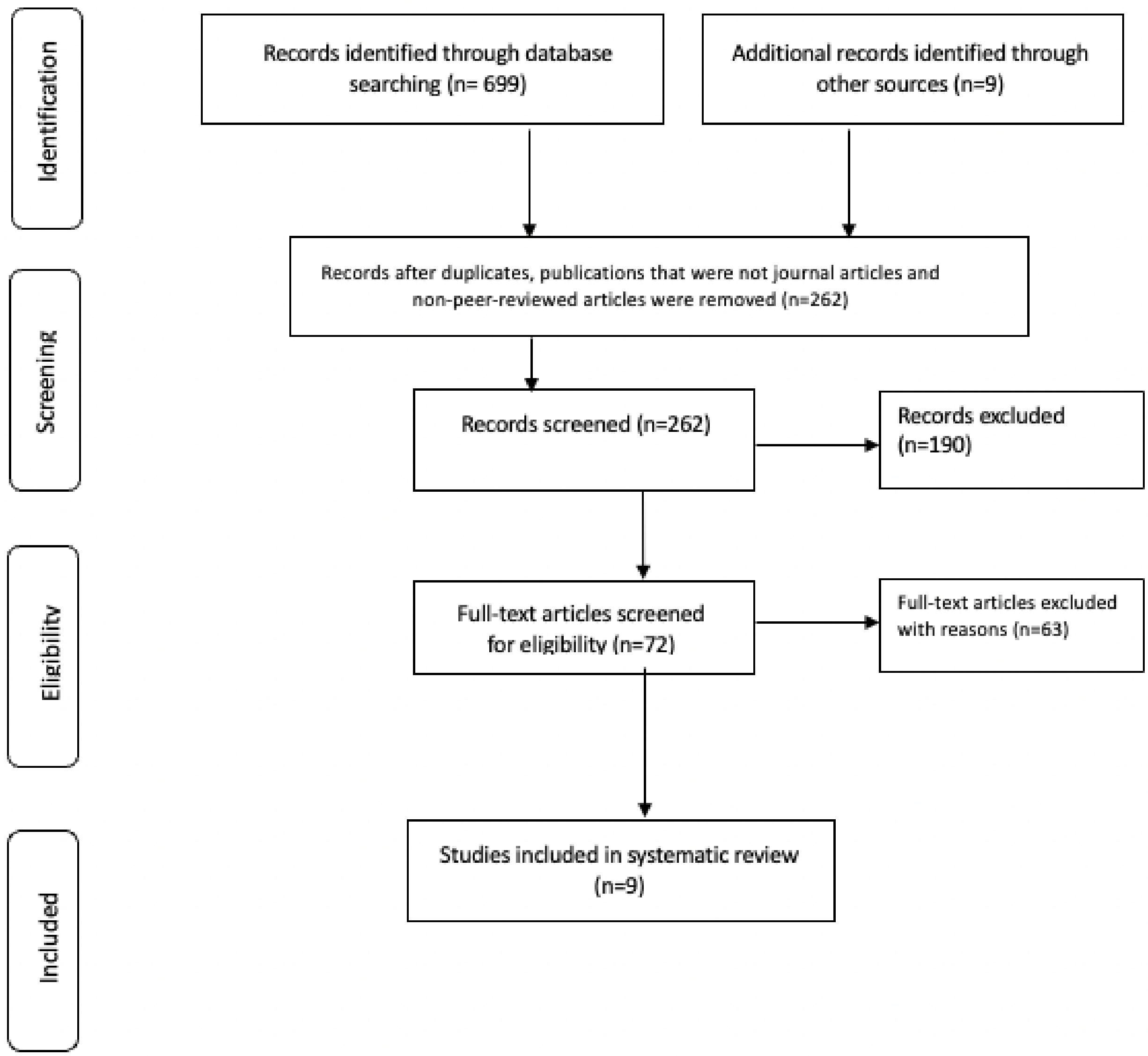


Table 3.
Inclusion and Exclusion Criteria and Rationale for Screening Studies

	Inclusion criteria	Exclusion criteria	Rationale
1. Participants in the sample	Young children in mainstream lower primary/elementary school.	Studies that included upper primary, adolescent or adult participants only.	This review is focused on lower primary/elementary school years.
2. Outcomes	Studies that focus on mathematical self-perceptions or enjoyment of maths and their impact on outcomes in maths.	Studies that focus on maths anxiety, maths cognition, motivation or mathematical engagement and outcomes only.	This review is focused on exploring the propensity for pupils' maths experiences to cultivate maths enjoyment and self-perception relating to maths.
3. Design	Quantitative, Qualitative and Mixed Method studies that explore the experiences of primary school children relating to maths.	Validity studies, systematic reviews, literature reviews and meta-analyses are excluded.	This review is focused on exploring the experiences of young children relating to maths, with qualitative and quantitative data to illustrate this.

4. Country where the research was carried out	Countries that have similar education systems and policies to Ireland (e.g., OECD countries).	Studies conducted in countries outside OECD or countries with ambiguous educational policies.	Pupils who reside in countries with educational contexts similar to Ireland are included as they may also experience similar conditions and elements which may contribute to fostering maths enjoyment and positive self-perceptions relating to maths, which may be relevant to the Irish context.
5. Date of publication	Any studies published from 1999 to present.	Studies published prior to 1999.	A new maths curriculum was introduced in September 2023. Prior to this, teachers had been following the 1999 curriculum. Therefore, it was important to consider articles from this period.
6. Language	The study was published in English.	The study was published in a language other than English.	This review is focused on studies that were published in English to mitigate potential discrepancies in translation that may alter meaning of findings.

Table 4.
List of included articles

Name of Article
1. Collingwood, C., & Dewey, A. (2018). 'Thinking your problems away': Can Mathematics interventions be developed to address both the academic and affective aspects of learning in primary aged children? *Emotional and Behavioural Difficulties, 23*(3), 267-280. https://doi.org/10.53841/bpsecp.2018.35.2.76
2. Lichtenfeld, S., Pekrun, R., Marsh, H. W., Nett, U. E., & Reiss, K. (2023). Achievement emotions and elementary school children's academic performance: Longitudinal models of developmental ordering. Journal of Educational Psychology, 115(4), 552-570. https://doi.org/10.1037/edu0000748
3. Mata, L., Monteiro, V., & Peixoto, F. (2022). Emotional profiles regarding maths among primary school children - A two-year longitudinal study. *European Journal of Psychology of Education, 37*, 391-415. https://doi.org/10.1007/s10212-020-00527-9
4. Dowker, A., Bennett, K., & Smith, L. (2012). Attitudes to Mathematics in primary school children. *Child Development Research, 2012*, Article 124939. https://doi.org/10.1155/2012/124939
5. Syväoja, H. J., Sneck, S., Kukko, T., Asunta, P., Räsänen, P., Viholainen, H., Kulmala, J., Hakonen, H., & Tammelin, T. H. (2024). Effects of physically active maths lessons on children's maths performance and maths-related affective factors: Multi-arm cluster randomized controlled trial. *British Journal of Educational Psychology, 94(*1), 1-19. https://doi.org/10.1111/bjep.12684
6. Arens, A. K., & Hasselhorn, M. (2015). Differentiation of competence and affect self-perceptions in elementary school students: Extending empirical evidence. *European*

Journal of Psychology of Education, 30, 405-419. https://doi.org/10.1007/s10212-015-0247-8

7. Boliver, V., & Capsada-Munsech, Q. (2021). Does ability grouping affect UK primary school pupils' enjoyment of Maths and English? *Research in Social Stratification and Mobility, 76,* Article 100629. https://doi.org/10.1016/j.rssm.2021.100629

8. Marks, R. (2016). Primary pupils' perceptions of mathematical ability. In *Proceedings of the Ninth Congress of the European Society for Research in Mathematics Education (CERME9)* (pp. 1610-1616). European Society for Research in Mathematics Education.

9. Tomasetto, C., Mirisola, A., Galdi, S., & Cadinu, M. (2015). Parents' math-gender stereotypes, children's self-perception of ability, and children's appraisal of parents' evaluations in 6-year-olds. *Contemporary Educational Psychology, 42*, 186-198. https://doi.org/10.1016/j.cedpsych.2015.06.007

The 63 excluded articles are depicted in Appendix B with reasons for exclusion. The final 9 articles were included for review based on their direct relevance to the research questions, their empirical focus, and the robustness of the methodology. These studies share a common focus on affective dimensions of Mathematics learning in primary-aged children. To provide clarity and a comparative overview of the evidence base, each of the included studies is summarised in Appendix C. This table maps key characteristics of the studies including author, country of origin, participants included in the review, research design, interventions where applicable, measures and main findings.

Framework for Review

The eligible articles were assessed for quality using Gough's Weight of Evidence (WoE; 2007) to regulate the systematic process of appraising the literature, ensuring transparency and rigour are embodied in the process throughout (Gough, 2021). This method of quality evaluation consists of three areas of relevance: Methodological Quality (WoE A), Methodological Relevance (WoE B) and Relevance of Evidence (WoE C). Each study is scored in these three areas and allocated an Overall Weighting (WoE D). In taking this approach, it is expected that the review of the literature would maintain a high standard. The WoE aided in the evaluation of capacity for each study to answer the review question. The WoE scoring is depicted in Table 5 below. For further detail on the weighting process, see Appendix D.

Table 5.
Weight of Evidence Scoring

	Collingwood & Dewey (2018)	Lichtenfeld et al. (2023)	Mata et al. (2021)	Dowker et al. (2012)	Syväoja et al. (2024)	Arens & Hasselhorn (2015)	Boliver & Capsada-Munsech (2021)	Marks (2016)	Tomasetto et al. (2015)
WoE A score and descriptive quality	3 High	2 Medium	3 High	2 Medium	2 Medium	2 Medium	2 Medium	2 Medium	2 Medium
WoE B score and descriptive quality	2 Medium	1 Low	1 Low	1 Low	3 High	1 Low	1 Low	1 Low	1 Low
WoE C score and descriptive quality	3 High	2 Medium	1.75 Medium	1.75 Medium	3 High	2 Medium	2 Medium	2 Medium	2 Medium
WoE D rating score (mean score of WoE A, B & C)	2.66	1.66	1.92	1.58	2.66	1.66	1.66	1.66	1.66
WoE D descriptive quality rating	High	Medium	Medium	Medium	High	Medium	Medium	Medium	Medium

Results

Participants

The focus of this review was to identify if mathematical self-perceptions and enjoyment contribute to differences in attainment and performance of primary school pupils. The total number of participants in the nine studies collectively was 10,962. The sample size ranged from 71 (Mata et al., 2021) to 8,876 (Boliver & Capsada-Munsech, 2021). All studies included children of primary school age. Participant ages were reported in all the studies. Differences in age range were evident, with the youngest reported participant aged 7 years (Boliver & Capsada-Munsech, 2021) and the oldest reported participant 11 years (Marks, 2016). In four studies, gender statistics were reported, with 131 female and 122 male participants (Tomasetto et al., 2015), 44% female and 56% male (Mata et al., 2021), 50.9% female (Year 2), 51.7% female (Year 3) and 51.2% female (Year 4) (Lichtenfeld et al., 2023) and 51.2 % female and 48.8% male (Boliver & Capsada-Munsech, 2021). Participants attended schools in various locations such as Portugal (Mata et al., 2021), England (Dowker et al., 2012; Marks, 2016), United Kingdom (Collingwood & Dewey, 2018; Boliver & Capsada-Munsech, 2021), Germany (Lichtenfeld et al., 2023; Arens & Hasselhorn, 2015), Finland (Syväoja et al., 2024) and Italy (Tomasetto et al., 2015). The first language of participants in four studies was English (Dowker et al., 2012; Marks, 2016; Collingwood & Dewey, 2018; Boliver & Capsada-Munsech, 2021), with participants in the remaining studies speaking English as an additional language.

Study Design

A range of research designs was employed across the nine studies included in the review. Four studies adopted a longitudinal cohort design (Lichtenfeld et al., 2023; Mata et al., 2021; Boliver & Capsada-Munsech, 2021; Marks, 2016), tracking participants over time to identify developmental changes in mathematical self-perceptions and enjoyment across primary school years. Cross-sectional designs were used in three studies (Dowker et al., 2012; Arens & Hasselhorn, 2015; Tomasetto et al., 2015), each collecting data at a single time point to explore aspects such as self-perceptions of mathematical ability

(Tomasetto et al., 2015), self-perceptions and effort (Arens & Hasselhorn, 2015), and attitudes toward Mathematics and performance (Dowker et al., 2012).

Only two studies evaluated interventions. Syväoja et al. (2024) employed a randomised controlled trial (RCT) to assess the impact of a physically active learning (PAL) intervention on mathematical self-perceptions and enjoyment, using a PAL group, a breaks group, and a control group. This study received a High WoE B rating, reflecting the robust nature of the RCT design. Collingwood and Dewey (2018) used a between-group, repeated-measures experimental design to evaluate the effectiveness of a Mathematics intervention targeting both academic performance and affective outcomes. This study was allocated a Medium WoE B rating, as it employed pre- and post-intervention measures but was not fully randomised, as cluster randomisation rather than individual randomisation was utilised. While this approach does not constitute individual-level randomisation, it is commonly used in research conducted in the educational context, in an effort to reduce potential contamination bias and to reflect real-world classroom settings (Dreyhaupt et al., 2017).

In contrast, the remaining seven studies did not include an intervention and therefore received Low WoE B ratings. While two of the intervention studies (Syväoja et al., 2024; Collingwood & Dewey, 2018) included post-intervention follow-up, the remainder of studies did not examine longer-term outcomes, which influenced their WoE C scores.

Notably, none of the studies explicitly detailed their sampling methods or recruitment strategies, leading to limitations in evaluating the transparency and representativeness of their samples. However, all studies were conducted within participants' natural school environments, which supports high ecological validity across the review.

Intervention

Out of the nine studies included in the current review, only two included interventions as part of their research design (Collingwood & Dewey, 2018, Syväoja et al., 2024). Collingwood and Dewey (2018) implemented the "Thinking Your Problems Away" Mathematics intervention, which was developed by the researchers. The intervention lasted for four weeks, with twelve sessions which included five key activities. These activities consisted of mindful breathing, using a thinking sheet, modelling and peer talk, using jokes and comic strips, and self-coping statements. Syväoja et al. (2024) used a PAL group, a breaks group and a control group. The intervention lasted for between 18 and 20 weeks, with the intervention ending before the intended time due to the COVID-19 pandemic. The remaining six studies included in the review did not implement an intervention, and this was reflected in their WoE B scores, receiving a Low rating for non-experimental studies.

Measures

Most of the studies which were included in this review utilised appropriate measures to gather data relating to mathematical self-perceptions, enjoyment and attainment outcomes, which are outlined in Table 5. Applying suitable measures is reflected in the methodological scores for the relevant studies . Five studies utilised rating scales or researcher-developed rating scales (Dowker et al., 2012, Arens & Hasselhorn, 2015, Boliver & Capsada-Munsech 2021, Marks 2016, Tomasetto et al., 2015). Of these five studies, two studies used other measures alongside the rating scales, improving the rigour of their findings (Dowker et al., 2012; Boliver & Capsada-Munsech 2021). Some studies also measured MA (Collingwood & Dewey, 2018, Dowker et al., 2012, Syväoja et al., 2024,), which contributed to the understanding of the findings in the context of the current review question.

Outcomes

The current review aimed to explore the potential impact of mathematical self-perceptions and enjoyment on performance and attainment of primary school pupils.

Several of the studies utilised appropriate measures of self-perceptions and attitudes towards Mathematics. Outcomes from the studies indicated that Mathematics performance can be impacted by mathematical self-perceptions of pupils, MA experienced by pupils and attitudes of pupils towards Mathematics.

Two studies included interventions (Collingwood & Dewey, 2018; Syväoja et al., 2024). Collingwood and Dewey (2018) utilised a researcher-developed Mathematics intervention, "Thinking your problems away." Findings indicated that there were some differences between groups in performance and self-regulatory behaviours such as strategising and focusing, but no significant group differences in MA or self-concept. Syväoja et al. (2024) in a randomised controlled trial, compared a PAL group, a breaks group and a control group. No group differences in mathematical self-perceptions or enjoyment were found, though increased MA was observed in the PAL group only.

Four studies were longitudinal (Lichtenfeld et al., 2023; Mata et al., 2021; Boliver & Capsada-Munsech, 2021; Marks, 2016). Lichtenfeld et al. (2023) found that as pupils progressed through elementary school, Mathematics enjoyment declined. Additionally, no changes in pupils' boredom or test anxiety were found. Learning-related anxiety was reported to decline when they progressed to Year 3 (approximately 9 years of age) and remain stable thereafter. Mata et al. (2021) also found that pupil enjoyment relating to Mathematics decreased and pupil boredom increased over time. Boliver & Capsada-Munsech (2021) found that children who experience ability groupings as part of their Mathematics education experience lower levels of Mathematics enjoyment when placed in lower ability groups. Marks (2016) found self-perceptions remained consistent over time, with pupils perceiving mathematical ability as biologically determined, and unrelated to groupings.

Three studies used a cross-sectional design (Dowker et al., 2012; Arens & Hasselhorn, 2015; Tomasetto et al., 2015). Dowker et al. (2012) found modest differences in year group attitudes, with boys rating themselves higher than girls rated themselves. Self-rating was linked to MA but not to performance. Arens and Hasselhorn

(2015) found affective self-perceptions were more strongly linked to effort than competence-related self-perceptions. Tomasetto et al. (2015) found that parents' gender stereotypes were associated with girls' lower self-perceptions, influenced by their perceptions of parental evaluations.

Studies which explored Mathematics enjoyment of pupils found a relationship between a decline in Mathematics enjoyment and the progression through stages in primary school. This indicates the salience of exploring attitudes such as mathematical self-perceptions and pupil evaluation of their enjoyment in Mathematics, as it can impact pupils' overall performance in Mathematics, willingness to engage in Mathematics-related tasks and activities and their educational trajectory beyond second level education, when choosing careers.

Conclusions and Recommendations

Summary of the Review

The aim of this review was to explore the potential impact of attitudes to Mathematics, such as mathematical self-perceptions, and enjoyment of Mathematics to impact pupil attainment and performance in the subject. The framework for appraisal chosen to evaluate the quality of articles was Gough's WoE framework (2007). This framework assisted in the evaluation of the capacity for the included articles in the current review to successfully answer the research question. The systematic nature of the implementation of the framework elicited results indicating that two studies provided robust evidence in relation to the review question (Collingwood & Dewey, 2018; Syväoja et al., 2024) due to the 'High' rating which they obtained overall. All nine studies provided insights relating to either mathematical self-perceptions or Mathematics enjoyment, which answers the research question of the current review. Additionally, two studies included measures of MA (Collingwood & Dewey, 2018; Dowker et al., 2012). This indicates an interaction between Mathematics enjoyment, self-perceptions and the development of MA. Findings indicate that Mathematics enjoyment decreases as pupils transition through primary school, while boredom increases (Lichtenfeld et al., 2023), which highlights the changing attitudes of pupils towards Mathematics. This is important as it encourages educators and researchers in the area to focus on why pupils' attitudes towards Mathematics may alter as they experience different pedagogies and curricula during their education. Findings from this study (Lichtenfeld et al., 2023) highlight the potential impact of curriculum and pedagogy on the maintenance of Mathematics enjoyment and positive self-perceptions relating to Mathematics.

Ability groupings were explored in two studies (Boliver & Capsada-Munsech, 2021; Marks, 2016), with children in lower-ability groups found to be adversely impacted in terms of their enjoyment of Mathematics (Boliver & Capsada-Munsech, 2021). This indicates the potential for external factors to impact a pupil's experience of Mathematics as they progress through primary school. Given that Mathematics activities and tasks become increasingly more challenging through primary and second-level education, it is possible that pupils begin to recognise differences between their abilities and those of their peers. While drawing this comparison with peers may not be detrimental to self-perceptions of children in higher-ability groupings, it is probable that children who are consistently placed in lower-ability groupings will acquire more negative mathematical self-perceptions.

It is also important to consider the potential for early intervention to bolster positive mathematical self-perceptions and cultivate Mathematics enjoyment in pupils who may experience MA. Some findings indicate that MA can impact self-perceptions of pupils (Dowker et al., 2012), as indicated by their self-rating relating to Mathematics. The type of intervention implemented may play a pivotal role, as Syväoja et al. (2024) found that MA was increased in the group who were exposed to the intervention condition only. This intervention group engaged in a PAL, which potentially did not provide the regulation necessary to combat MA, and instead resulted in increased arousal. Additionally, this intervention was conducted during the COVID-19 pandemic, which may have skewed the findings, given the context of uncertainty in the world at that point.

Regarding Mathematics enjoyment, findings from the current review indicate that pupils' Mathematics enjoyment levels decrease over time, as they progress through curriculum stages. While previous research has suggested that as Mathematics becomes more challenging, Mathematics enjoyment levels begin to decline, this review found that Mathematics enjoyment is more impacted by boredom than challenges. This indicates that certain teaching methodologies and pedagogies may be critical for inspiring pupil engagement with Mathematics.

Limitations of the Review

Some studies in the current review lacked detailed methodological descriptions, making it difficult to discern precise research designs. Several studies utilised longitudinal data and cross-sectional designs, however only one study adopted a randomised approach (Syväoja et al., 2024), however, the randomisation was conducted at the cluster level rather than the individual level, which is common in school-based research. Despite this, due to the study's robust design features including clear intervention processes, control groups and the use of measures, it received a High rating in the WoE appraisal. Inclusion of additional randomised controlled trials may have increased the rigour of the review as it would have been easier to draw conclusions based on the impact of the implementation of an intervention, given that the intervention is the only difference between intervention and control groups participating in the study. Differences in constructs being measured in the included studies made it difficult to compare outcomes. It may have been more appropriate to conduct a review of either Mathematics enjoyment or mathematical self-perceptions, which would have created a more direct comparison between research designs, samples, measures and outcomes. Consequently, it highlights the potential for future research to include both mathematical self-perceptions and Mathematics enjoyment, as this indicates a gap in the literature.

Areas of Further Research

While the studies included in the current review generally employed appropriate psychometric measures, a notable gap was the limited use of qualitative methods. The inclusion of additional qualitative details would have enriched understanding by providing deeper insight into the lived experiences and perspectives of pupils. This gap is addressed in the present empirical study, which explores the perspectives of both pupils and teachers in Irish primary schools regarding Mathematics enjoyment and mathematical self-perceptions. By incorporating the voices of these key stakeholders, the study offers a more holistic understanding of the affective elements of Mathematics learning, particularly within the context of the recently implemented Redeveloped Primary Mathematics Curriculum.

In addition, although several longitudinal studies were included in the review (Lichtenfeld et al., 2023; Mata et al., 2021; Boliver & Capsada-Munsech, 2021; Marks, 2016), which proved valuable in observing changes in pupils' perceptions and enjoyment of Mathematics over time, only two studies (Collingwood & Dewey, 2018; Syväoja et al., 2024) used a randomised controlled design. Future research could benefit from a stronger focus on intervention-based designs to identify effective, evidence-based strategies that schools can implement to foster positive mathematical self-perceptions and enjoyment among primary pupils.

Furthermore, future reviews could explore how short-term interventions might bolster these affective outcomes and consider interacting variables such as Mathematics anxiety (Dowker et al., 2012; Collingwood & Dewey, 2018), gender (Dowker et al., 2012), and the effects of ability grouping (Boliver & Capsada-Munsech, 2021; Marks, 2016). Capturing the voices of pupils, teachers, and parents in such research would enhance contextual understanding and support the development of responsive, child-centred educational practices.

Empirical Paper

Introduction

The Necessity of Mathematics

Mathematics attainment is fundamental to the everyday lives of adults assisting with several outcomes such as educational trajectory, profession, financial literacy and understanding the economy (Evans & Field, 2020). This indicates the salience of exploring barriers and facilitators of mathematical success and positive outcomes. It has been suggested that adults with low Mathematics attainment are limited in choice of career and are at increased risk of potentially experiencing socioeconomic disadvantage such as homelessness, engaging with the authorities relating to criminal activities, health challenges and unemployment (Evans & Field, 2020). These outcomes highlight the importance of addressing barriers to mathematical success and the role of educational professionals, such as educational psychologists, in supporting improved outcomes.

Key factors contributing to mathematical success include pupils' self-perception of competence, self-efficacy, personal interest and motivation (Rodríguez et al., 2020). Pupils with positive self-beliefs are more likely to succeed, while negative self-beliefs can lead to Mathematics anxiety (MA) and underachievement. Promoting positive self-beliefs may therefore act in a protective capacity in the development of mathematical competence.

Research has predominantly focused on MA, and its impact on attainment, with less emphasis on confidence, enjoyment and positive attitudes (Hunt & Maloney, 2022; Christensen & Knezek, 2020). Cultivating positive attitudes could boost pupils' engagement and persistence, despite mathematical challenges they may encounter (Duda & Garrett, 2008).

Factors impacting Mathematical Success

Mathematical success is influenced by both individual and contextual factors. Individual factors include self-esteem (Mazzocco, 2007), self-concept and MA (Kaskens, 2020). MA, characterised by feelings of fear and inadequacy, impacts pupil performance in Mathematics (Hembree, 1990), predicts avoidant behaviours (Maloney & Beilock, 2012) and can create a cycle of negative attitudes and avoidant behaviours. Contrastingly, positive self-concept and confidence support persistence and achievement (Seaton et al., 2013).

Contextual factors such as teacher support, school culture, and family involvement also influence mathematical outcomes. Supportive teachers who value effort and growth can enhance engagement and performance (Roorda et al., 2011; Sandilos et al., 2017). A school culture that encourages learning from mistakes and values collaboration further supports success (Boaler, 2016; Boaler et al., 2022). Parents' attitudes also shape children's beliefs, with parental encouragement linked to greater motivation and achievement (Peixoto et al., 2024). Societal attitudes, including beliefs about innate mathematical ability or gender differences, can also impact pupils' self-perceptions and engagement (Jennifer et al., 2024; McCoy et al., 2022).

Mathematics Teaching and Learning in Irish Primary Schools

In Ireland, Mathematics teaching recently shifted from the 1999 Primary School Curriculum to the 2023 Redeveloped Primary Mathematics Curriculum. The former promoted play-based pedagogy in early years (junior infants to second class), integrated with the Aistear Framework. As pupils moved into first- and second- class (aged 7-9 years), written operations and problem solving were introduced alongside concrete materials.

The 2023 curriculum extends play-based, child-centred approaches across all primary levels, aiming to better meet pupil needs. This pedagogical shift aligns with Bruner's influential theory of learning (1960), which advocates for the progression from concrete to abstract understanding through active, meaningful experiences. By framing learning initially through tangible, play-based contexts, pupils are enabled to form understandings that support abstract reasoning as they progress through the curriculum (Bruner, 1960; Fleer, 2010). The Irish curriculum reform echoes Bruner's vision by acknowledging that sustained opportunities for exploration are essential not just for young children, but throughout primary school to scaffold their reasoning abilities

(NCCA, 2023). Grounding learning in concrete, child-led experiences allows for the development of more durable understanding, which enables children to move from concrete to representational and finally abstract understanding of Mathematics concepts as they progress through primary school (Clements & Sarama, 2009; Sarama & Clements, 2007).

While some interventions are in place—such as *Ready, Set, Go Maths* and *Maths Recovery*, mostly in DEIS schools—these primarily target attainment and conceptual understanding. One Irish intervention using the videogame *Once Upon a Maths* (Rocha & Dondio, 2021) aimed to reduce anxiety and improve performance, though results were mixed and highlighted gender-related differences in response.

NEPS has also produced a *Good Practice Guide for Teachers* (2020), but existing supports largely focus on remediating needs rather than proactively promoting positive mathematical self-perceptions, confidence, and enjoyment. Although there is growing recognition of the importance of affective factors, there remains a lack of targeted, strength-based supports in Irish classrooms.

> <u>Excerpt from Reflective Journal:</u> In my final year of teaching, I worked as a Special Education Teacher (SET), providing literacy and numeracy support to a group of first-class pupils whose performance was significantly behind that of their peers. These five children, having missed much of Junior and Senior Infants due to COVID-19, frequently expressed negative attitudes toward Mathematics and showed fear of trying. My role focused on delivering additional instruction to build knowledge and skills, though their negative attitudes clearly impacted their enjoyment, self-perceptions and performance. I wonder if approaching the affective factors might have supported more meaningful progress for these pupils.

Promoting Positive Mathematical Experiences

Promoting positive mathematical experiences in the formative years is essential, particularly from an emotional perspective, as these positive experiences are reinforced over time, and predict perseverance, coping skills and motivation to continue engaging with the subject as it becomes more difficult. Pekrun (2006) highlights the emotional aspects which impact mathematical experiences, such as anxiety and enjoyment, whist

Fredricks et al. (2004) emphasises the importance of engagement, inclusive of cognitive, emotional and behavioural domains.

Emotions play a central role in education, as they have the propensity to impact cognitive processes and strategies, in addition to a pupil's capacity to make decisions and also influences their motivation to persevere through challenging tasks (Kim & Pekrun, 2013). A reciprocal relationship between emotions such as enjoyment and anxiety and mathematical achievement has been identified, which is thought to predict the possibility of a future career in STEM fields (Ahmed, 2018). Van der Beek et al. (2017) proposed that mathematical self-concept mediates the relationship between Mathematics anxiety and achievement to some degree. Additionally, positive correlations between Mathematics enjoyment and achievement have been reported in several studies with children at varying stages of primary school (Fisher et al., 2012; Frenzel et al., 2007; Ahmed et al., 2013). Pinxten et al. (2014) found that there was a mediating role of competence beliefs, which are closely aligned with pupils' self-perceptions of their mathematical ability, in the relationship between Mathematics enjoyment and achievement in the subject. Russo et al. (2023) found that in pupils from 7-15 years of age, negative attitudes emerged as a direct result of declining levels of enjoyment. Collectively, this information suggests that both enjoyment and competence beliefs, which include self-perception, play a key role not only in achievement, but also in maintaining positive affect and enjoyment towards Mathematics. Having identified the central role of emotions and competence beliefs when understanding mathematical achievement, cultivating positive self-perceptions by enhancing pupils' learning experience is essential for promoting achievement and wellbeing.

Boosting pupils' self-perceptions of ability through cultivating successful experiences supports positive Mathematics engagement and wellbeing (Rodríguez et al., 2020). Grant and Dweck (2003) argue that pupils who link success to effort view ability as improvable, which increases resilience to failure. In contrast, pupils focused on performance attribute failure to task difficulty, which increases anxiety and negatively impacts self-perceptions (Bonnett et al., 2017). Therefore, a growth mindset, which emphasises the role of effort, helps pupils maintain positive self-perceptions and enjoyment despite challenges.

Bonnett et al. (2017) highlight that a mastery-focused classroom can reduce negative perceptions of learning tasks, demonstrating how external factors impact the mathematical experience. This aligns with Bronfenbrenner and Morris's (2006) Bioecological Model, which considers contextual factors like type of activity and groupings (Bonnett et al., 2017). Ability grouping, especially placing pupils in lower ability groups, may harm mathematical self-perceptions (Boliver & Capsada-Munsech, 2021). Avoiding ability grouping and promoting inclusive, mastery-based practices can foster positive self-perceptions and greater enjoyment of Mathematics.

The concepts of mathematical self-perceptions and enjoyment were specifically chosen for this study as they represent key affective dimensions of pupils' engagement with mathematics. These constructs are highly relevant in early childhood education, where learners are forming foundational beliefs about their capabilities and attitudes toward subjects (Montague & van Garderen, 2003; Aunola et al., 2006). Unlike anxiety or performance alone, self-perceptions and enjoyment align more closely with a strengths-based lens, capturing both the cognitive belief in one's ability and the emotional response to mathematical engagement, both of which have been shown to impact long-term academic outcomes and wellbeing (Dowker et al., 2019; Rodríguez et al., 2020). These constructs also mirror the shift in the Redeveloped Primary Mathematics Curriculum toward fostering confidence, creativity, and playfulness in mathematics learning (DE, 2023).

In an effort to effectively explore positive experiences of pupils, this study is underpinned by theoretical and conceptual frameworks that accentuate the significance of self-perceptions, enjoyment, the systems around the pupil and pupil voice.

Framing the Study: Theoretical Frameworks

The study is underpinned by two key theoretical perspectives: Bronfenbrenner and Morris' Bioecological Model (2006) and Seligman's PERMA Framework (2011).

These frameworks interact and allow a strengths-based approach to be taken to investigate mathematical experiences of Irish primary school pupils. The Bioecological Model highlights the interplay of systems which impact children's development. These systems are microsystem, mesosystem, exosystem and macrosystem. This model considers proximal processes, and frames these under the Process-Person-Context-Time (PPCT) framework. The PPCT model facilitates a holistic approach to explore the interaction between environmental systems and individual factors over time to mould development. 'Process' examines the reciprocal interactions of an individual and the factors in their immediate environment which can include people and objects. Observing how these interactions progress over time is essential to determining the influence of interactions on the individual's development. In the context of pupil experiences of Mathematics, daily classroom interactions, pedagogical practices and lesson design all contribute to this aspect of the PPCT model. 'Person' refers to the individual attributes of the pupil, and how they engage and respond to their environment based on these attributes. Various factors contribute to pupils' perception of mathematical ability, including, confidence or self-efficacy (Pajares, 1996), temperament and individual differences influencing motivation (Stipek, 2002), how they engage with lessons (Martin & Rimm-Kaufman, 2015) and response to feedback from their teachers (Hattie & Timperley, 2007). 'Context' encompasses the systems around the child, such as the microsystem, mesosystem, exosystem and macrosystem. Microsystems refer to the contexts, and attitudes within those contexts, that the child experiences daily, such as home or school. The classroom environment, teacher practices, classroom interactions and parent attitudes towards Mathematics all contribute to the micro system. The mesosystem refers to interactions within the microsystem, such as teacher-parent cooperation. The exosystem refers to indirect influences on the individual, such as school's decision to prioritise Mathematics as an area for development within their School Self-Evaluation. The macrosystem refers to societal norms and cultural context, such as the implementation of the Redeveloped Mathematics Curriculum, which represents a cultural shift in framing the teaching and learning of Mathematics. 'Time' incorporates micro-time, meso-time and macro-time which capture experiences of pupils as they unfold over time, in different dimensions. Micro-time refers to daily engagement during Mathematics lessons, the experiences of pupils and how they help to shape their development. Meso-time refers to a longer period, such as the school year, where pupils progress and can develop their self-perceptions based on an evaluation of their progress. Macro-time refers to long-term influence which can be impacted by educational reforms or policy. The Bioecological Model allows for understanding of the role of both systems and proximal processes in exploring pupil experiences of Mathematics.

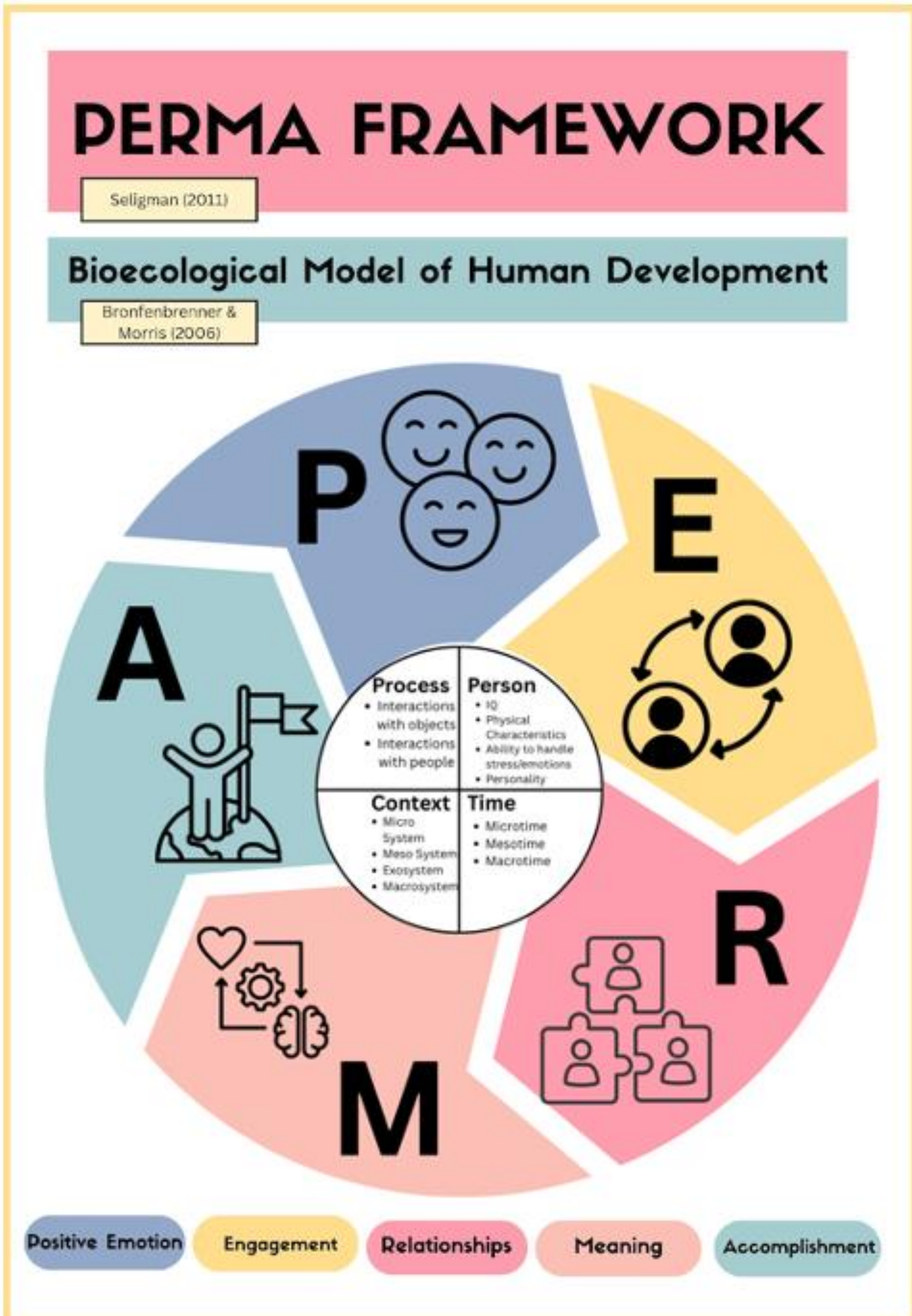
In addition to providing the ecological perspective, the PERMA framework (Seligman, 2011) frames the experiences of pupils within five elements; ‘Positive Emotion’, ‘Engagement’, ‘Relationships’, ‘Meaning’ and ‘Accomplishment’. This framework facilitates an exploration of mathematical experiences, from a strengths-based perspective, and allowing for emotional and relational factors to be considered. Figure 4 shows the integrated models.

Collectively, both frameworks facilitate a holistic approach to considering mathematical experiences of pupils, acknowledging both the environmental and internal supports necessary to promote positive experiences for pupils within the context of the Redeveloped Mathematics Curriculum (DE, 2023).

Excerpt from Reflective Journal: From my experience as a primary school teacher, the aim and focus has generally been on academic outcomes of pupils. The curriculum provides a guide to help children achieve age-appropriate outcomes. As a teacher, the core subjects (Maths, English and Irish) were always given priority, often at the expense of SPHE, PE, Drama, Music; subjects which cater more toward general wellbeing. Incorporating both frameworks encouraged me to think beyond academic performance and consider the emotional, relational and contextual aspects of child development. This has influenced how I now approach school visits and consultations in my new role as trainee psychologist.

Figure 4.

An Integrated Model of Environmental and Personal Factors Influencing Pupils' Mathematics Enjoyment and Self-Perceptions (Bioecological and PERMA Frameworks)



Current Study

The current study explores teacher and pupil perspectives of mathematical self-perceptions and Mathematics enjoyment, in the context of the Redeveloped Mathematics Curriculum (DE, 2023), which has recently been implemented. Previous literature in the area has predominantly adopted a deficit-based approach, exploring mathematical anxiety, primarily in senior classes or second-level education (Ramirez et al., 2018; Sorvo et al., 2017; Luttenberger et al., 2018). Drawing from the gaps identified in the systematic review, the empirical study was refined to explore these constructs in practice, focusing on first- and second-class pupils and their teachers during the implementation of the Redeveloped Mathematics Curriculum.

This mixed-methods study involved pupils in first- and second- classes, who completed a survey exploring mathematical self-perceptions and Mathematics enjoyment. A small cohort of pupils also engaged in qualitative data collection, using the Mosaic approach (Clarke & Moss, 2011), which is a child-friendly approach aimed at capturing the child's voice. This involved the children bringing the researcher on a tour of the school and taking pictures that they associated with Mathematics in the school environment. Children then used these pictures to create collages and drawings which formed the basis for the discussion on their experience of Mathematics.

Teacher perspectives were also explored using an online open-ended survey. This open-ended survey aimed to capture teacher perspectives specifically relating to the introduction and implementation of the Redeveloped Mathematics Curriculum. Distinct from previous studies, which have focused on mathematical attitudes and the impact on mathematical achievement or performance (Dowker et al., 2012; Putwain et al., 2021), this study focused primarily on mathematical self-perceptions and Mathematics enjoyment , with a particular focus on capturing pupil and teacher voices. The recently released Redeveloped Mathematics Curriculum for primary schools (September 2023) has suggested a greater play pedagogy focus, which aims to bolster curiosity and enjoyment of Mathematics. No research has yet been conducted in Ireland relating to mathematical self-perceptions and enjoyment of pupils, in the context of the Redeveloped Primary Mathematics Curriculum.

The following research questions are examined:

1. What are, if any, the differences in mathematical self-perceptions between first- and second- class pupils in Irish primary schools?
2. What are, if any, the differences in Mathematics enjoyment between first- and second- class pupils in Irish primary schools?

Method

Research Design

The research design consisted of an exploratory mixed methods design, and was underpinned by the pragmatic research paradigm, which emphasised the importance of flexibility in research and focused on practical solutions and their relevance and application to real-life scenarios. The research was guided by the PERMA framework (Seligman, 2011) and Bronfenbrenner and Morris's Bioecological Model of Human Development (Bronfenbrenner & Morris, 2006). These frameworks guided the development of the open-ended teacher survey. The questions explored the key areas of both frameworks such as 'Process', 'Person', 'Context', 'Time' (Bioecological Model; Bronfenbrenner & Morris, 2006) and 'Positive Emotion', 'Engagement', 'Relationships', 'Meaning' and 'Accomplishments' (PERMA Model; Seligman, 2011).

Procedures

Quantitative Data Collection: Measurement of Pupil Enjoyment and Self-Perceptions relating to Mathematics. Convenience sampling was used to recruit participating schools. The researcher contacted schools in which she had previously taught and invited them to participate in the research study. Two schools responded, details of which are conveyed in Table 6. Data collection occurred on one day in each of the participating schools in December 2024.

<u>Excerpt from Reflective Journal:</u> Sampling was a significant challenge, as schools didn't have the capacity to participate. On reflection, going through the ethical process with NEPS could have simplified this. Acknowledging attractiveness of the study to schools; what do they get from it? Exploratory research may not appeal to schools in the same way that intervention research does. The use of convenience sampling undoubtedly impacted pupil responses as the researcher was known, especially in the context of School A.

Table 6.
Details of participating schools.

	School A	School B
Number of Pupils	376	470
Number of Teachers	24	52 (11 of these posts currently unfilled)
DEIS*	DEIS Band 2	DEIS Band 1
Urban or Rural	Urban	Urban
Patronage	Catholic Church	Catholic Church
Gender	Girls	Mixed

*DEIS schools are part of a government initiative to reduce educational disadvantage

Consent forms were distributed by the schools to parents of children in first- and second- classes. Out of a possible 120 forms, 94 were returned with consent provided by parents for their child's participation in the project. Parent consent forms and plain language statement can be found in Appendix E. Out of the 94 forms returned, 4 children chose not to participate in the research project, and returned to their classroom following informed consent. 90 children in total, across both schools participated.

On the day of data collection, the researcher prepared and arranged school iPads, ensuring they were charged, with the plain language statement (Appendix F), informed assent (Appendix G) and survey (Appendix H) windows open. The researcher introduced herself to the class and explained that she would be chatting with some of the children in the class during the day. The researcher withdrew small groups of children, of no more than 10, to administer the survey measure (Adelson & McCoach, 2011). The researcher explained the child-friendly plain language statement (Appendix F) and invited the children to provide assent if they wished to do so (Appendix G). Children who did not provide assent were not directed to survey items, as the online survey had been designed in Qualtrics with the 'skip logic' function, ensuring only children who provided assent would progress to the survey items. Children were then guided through the completion of the Math and Me measure (Adelson & McCoach, 2011). The researcher explained the response options and completed unrelated items for practice (e.g. "I am good at football" and "I like chocolate"). The researcher checked for understanding of the response options, before reading out each item to the small group of children and providing adequate time for them to indicate their response. It took approximately 10 minutes to administer, which included informed consent, administration of the measure and checking that children provided a response for each item. The data was downloaded directly to SPSS to conduct data analysis. All pupil surveys were completed in the morning, with qualitative data collection occurring in the afternoon.

Qualitative Data Collection-Measurement of teacher and pupil perspectives of Mathematics enjoyment and self-perceptions. A Mosaic approach (Clarke & Moss, 2011) was used to obtain qualitative data from the children (Appendix I). This approach is child-friendly and focuses on using a variety of approaches to access the authentic voice of children. For the current study, it involved tours of the school taking photographs, completing drawings, and creating maps to stimulate discussion with the researcher. Teachers selected three pupils who they believed would be comfortable engaging in this process with the researcher. Pupils used pictures they had taken around the school to create collages, categorising them under headings such as "Maths at my Desk", "Maths in my Classroom", "Maths in my School" and" Maths Outside." Pupils used these collages along with drawings depicting their favourite Mathematics lesson to stimulate discussions regarding their experiences of teaching Mathematics. Teachers of first- and second- classes, along with the Special Education Teacher assigned to their class were invited to complete an online questionnaire (Table 9). Details of participating teachers are displayed in Table 7.

Table 7.
Details of Participating Teachers/Setting

Variable	Category	Frequency	Percentage
Gender	Male	2	29%
	Female	5	71%
Level of Experience	0-5 years	1	14%
	6-10 years	3	43%
	11-15 years	2	29%
	15+ years	1	14%
School setting	Urban (City)	3	43%
	Urban (Town)	4	57%
School designation	DEIS Band 1	3	43%
	DEIS Band 2	4	57%
Language of School	English	7	100%
School Ethos	Catholic	7	100%
Type of School	Vertical School	4	57%
	Junior School	3	43%
Gender of Pupils	Girls	4	57%
	Boys and Girls	3	43%
Current role	Mainstream Class Teacher	4	57%
	Special Education Teacher	3	43%
Training in Redeveloped Curriculum received?	Yes	7	100%
	No	0	0%

Participants

One first and one second class in each of two schools participated in this research. The research was conducted with children in first- and second- classes (age seven to nine years), and their teachers. Pupils participated in quantitative and qualitative aspects of the research. 89 pupils participated in the quantitative aspect of the study, with 53% of responses provided by children in 2nd class and 47% of responses provided by children in 1st class. 27% of responses were provided by male pupils and 72% of responses were provided by female pupils, owing to the fact that one of the schools was for females only. 49% of responses were provided by pupils who attend a DEIS Band 1 school, with the remaining responses provided by pupils who attend a DEIS Band 2 school. DEIS Band 1 schools face the highest level of disadvantage and receive intensive supports. DEIS Band 2 schools experience a moderate level of disadvantage and receive targeted, less intensive supports. First- and second- class pupils were deemed appropriate for this research due to the insight they could provide into their experiences of pupil enjoyment of Mathematics and mathematical self-perceptions, in the context of the Redeveloped Mathematics Curriculum (2023). Online open-ended surveys were distributed to all class teachers and members of the schools' Special Education Team who were involved with these classes. Four class teachers and three SET teachers provided responses, which were used to explore teacher perspectives of pupils' mathematical self-perceptions and Mathematics enjoyment.

Measures

Quantitative data was collected through two separate online surveys, created using Qualtrics, which is an online platform designed to enable the development, sharing and completion of online surveys. One survey was created for participating children (Appendix H) and consisted of items from the Math and Me survey (Adelson & McCoach, 2011). Two subscales from this survey were utilised in this study: mathematical self-perceptions and enjoyment of Mathematics. A plain language statement (PLS) was also included (Appendix F), detailing information regarding the research study, what would be expected of the participants, should they choose to consent to participation and how their data would be managed. Sample items from the Math and Me survey have been included in Table 8.

<u>Excerpt from Reflective Journal:</u> Use of the term "math" rather than "maths." My instinct was to change the term to reflect what is used in Irish classrooms. On reflection, in the context of the research being undertaken in two DEIS schools, I wondered if I was being biased in thinking about potential participants for the research; am I assuming all participating children will be Caucasian, Irish children? From my experience of teaching abroad, many Arab, Pakistani, Indian and American families (to name but a few) use the term "math." I decided not to change the term and explained it during the administration to the children. No notable issues were observed or reported during data collection.

Table 8.
Sample Items from Math and Me Survey

Subtest	Survey Item	Corresponding elements in Theoretical Frameworks
Mathematical Self-Perceptions	I think I am really good at math	**PPCT:** Person; individual traits: competence beliefs, motivation
	I understand math	
	I can solve difficult math problems	**PERMA:** Accomplishment; pupil's sense of mastery
	Math is very hard for me	
	Math is confusing to me	
	Math comes easily to me	
	I can tell if my answers in math make sense	
	Doing math is easy for me	
Enjoyment of Mathematics	I love math	**PPCT: Process and Context** - impact of reciprocal interactions in the classroom (microsystem) and curriculum (macrosystem)
	Math is boring	
	I enjoy doing math puzzles	
	I do math problems on my own "just for fun"	
	Math is fun	**PERMA:** Positive Emotion and Engagement; provides pupils with an opportunity to convey joy, interest and engagement with Mathematics.
	I look forward to learning new math	
	I hate math	
	I enjoy playing math games	
	I enjoy studying math	
	Solving math problems is fun	

The use of the Math and Me survey (Adelson & McCoach, 2011) was deliberately aligned with the focus on self-perceptions and enjoyment. This validated instrument includes subscales that explicitly capture pupils' beliefs about their competence in mathematics (e.g., "I think I am really good at math") as well as their affective responses (e.g., "I enjoy studying math"), making it a suitable measure for examining these two interlinked constructs. Furthermore, the Mosaic Approach (Clarke & Moss, 2011) complemented this by allowing children to express their enjoyment and self-concept through drawings, taking photographs, making collages, and having conversations with each other and the researcher, enhancing the depth and authenticity of the data collected from younger pupils. These tools were selected for their developmental appropriateness and alignment with the theoretical underpinnings of the study, particularly the PERMA framework's emphasis on 'Positive Emotion', 'Engagement', and 'Accomplishment', and the proximal processes (PPCT) that children engage in which impact their experiences of Mathematics.

Separate informed consent (Appendix J) and an online open-ended survey (Table 9) was created for participating teachers. The PLS described the research study in detail and how participants' data would be used. The survey consisted of seven questions. Teachers were asked open-ended questions, which endeavoured to explore the research questions through the lens of both theoretical frameworks. An overview of the questions that teachers were invited to respond to is displayed in Table 9.

Table 9.
Questions from Teacher Online Survey and Theoretical Frameworks underpinnings

Online Survey Question	**Corresponding elements in Theoretical Frameworks**
1. What aspects of the school culture and environment help to foster positive self-perceptions relating to Mathematics for pupils?	**(Context- Microsystem, Mesosystem) -** PPCT (Process, Person, Context, Time) **(Relationships) -** PERMA framework

2. What aspects of teaching and learning cultivate Mathematics enjoyment in pupils?	**(Process - Proximal Processes) -** PPCT (Process, Person, Context, Time) **(Positive Emotion) (Engagement) -** PERMA framework
3. Is there a difference in Mathematics enjoyment of pupils as they transition to 1st/2nd class?	**(Time - Micro- & Meso-time) -** PPCT (Process, Person, Context, Time) **(Positive Emotion) (Engagement) -** PERMA framework
4. Has the Redeveloped Mathematics Curriculum changed pupil enjoyment of Mathematics?	**(Context -Exosystem; Time - Macrotime) -** PPCT (Process, Person, Context, Time) **(Positive Emotion) -** PERMA framework
5. Have you observed differences in self-perceptions of pupils relating to Mathematics since its implementation?	**(Process - Microsystem and Mesosystem; Context - Microsystem and Mesosystem; Time - Meso-time) - PPCT** (Process, Person, Context, Time) **(Meaning) (Accomplishment) -** PERMA framework
6. Do you feel you teach Mathematics differently since CPD on the Redeveloped Mathematics Curriculum?	**(Person (Teacher); Context - Mesosystem/Exosystem) -** PPCT (Process, Person, Context, Time) **(Engagement) -** PERMA framework
7. Are members of the wider school community involved in building enjoyment of Mathematics? (If yes, what do they do?)	**(Context- Exosystem, Mesosytem, Microsystem; Process)** - PPCT (Process, Person, Context, Time) **(Relationships) (Positive Emotions) -** PERMA framework

Data Analysis

Quantitative data was analysed using SPSS (Version 29), which allowed the researcher to compare the experiences of first- and second- class pupils. Participants provided demographic data such as class level, gender and school type (See Table 10).

The data was initially screened and cleaned, with the researcher identifying and excluding missing data. Independent samples t-tests were used to compare the experiences of pupils and evaluate mathematical self-perceptions and enjoyment of Mathematics across both cohorts. Correlation analysis explored if there was a relationship between item responses of pupils. Linear regression analysis evaluated if gender and class level contributed to variance in Mathematics enjoyment and self-perceptions.

Table 10.
Demographic data of pupil participants

Variable	**Category**	**n**	**%**
Class Level	First Class	42	47%
	Second Class	47	53%
Gender	Male	24	27%
	Female	65	72%
School Type	DEIS Band 1	44	49%
	DEIS Band 2	45	51%

Qualitative data was analysed using Reflexive Thematic Analysis (Braun & Clarke, 2021), which consists of a six-phase model of data analysis. As two sets of participants were included in the qualitative data collection, teacher responses and pupil responses were analysed separately, to extract appropriate themes pertinent to both sets of participants, and reflective of their specific experience. 12 pupil participants took part in the qualitative aspects, including first class (*n*=6) and second class (*n*=6) pupils. 6 teacher participants (4 mainstream teachers and 2 SET) took part in the teacher online survey. NVivo software was used to organise the qualitative data, transcribing and coding the data, which enabled the researcher to extract appropriate themes. Phase 5 from the Codebook can be found in Appendix K.

Ethical Considerations

Ethical approval was applied for and granted from the Mary Immaculate College Research Ethics Committee (MIREC); MIREC Approval Number: A24-051, which can be found in Appendix L. Due to the study context and participant population, there were several ethical considerations to be examined. Children are deemed to be a vulnerable population in research (Kodish, 2003), and therefore research ethics are of paramount importance during the research process. It is essential to protect participants and identify potential adversities and how to manage such adversities should they occur. Ethical considerations and guidelines have been proposed by both the Psychology Society of Ireland (PSI) and the British Psychology Society (BPS), both of which were consulted during the process of establishing ethical considerations for the current study.

Results

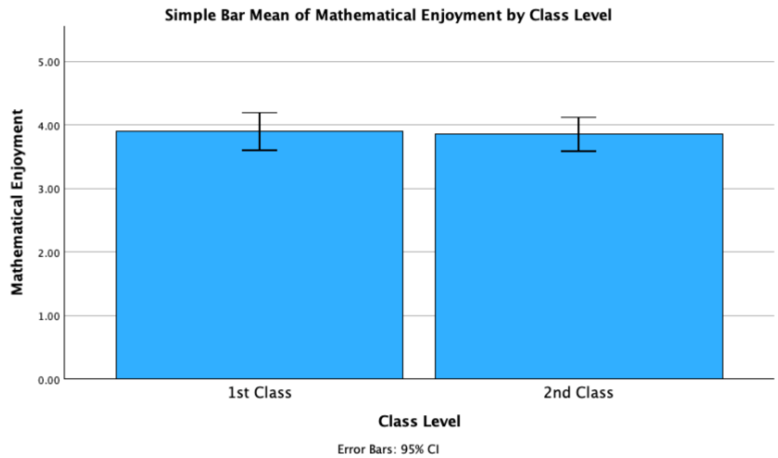
Quantitative Findings

Overview of Quantitative Analyses. A series of quantitative analyses were conducted on data gathered from pupils in first- and second- classes. These analyses examined group differences, associations between items on the Math and Me survey (Adelson & McCoach, 2011) and the predictive value of gender and class level. First, independent samples t-tests were performed to determine if there was a statistically significant difference between children in first- and second- classes on mathematical self-perceptions and enjoyment. Next, Spearman's rank-order correlation analyses were utilised to evaluate if there was a relationship between negatively worded (opposite) item responses related to pupils' attitudes towards Mathematics, as the data were not normally distributed. Finally, linear regression analyses were conducted to evaluate the extent to which gender and class level accounted for variance in Mathematics enjoyment and self-perceptions, allowing for both individual and combined predictive effects.

Group Differences. Independent samples t-tests were conducted to evaluate if pupils' mathematical self-perception scores differed significantly based on class level. Conducting these tests allowed for the comparison of mean scores between different year groups.

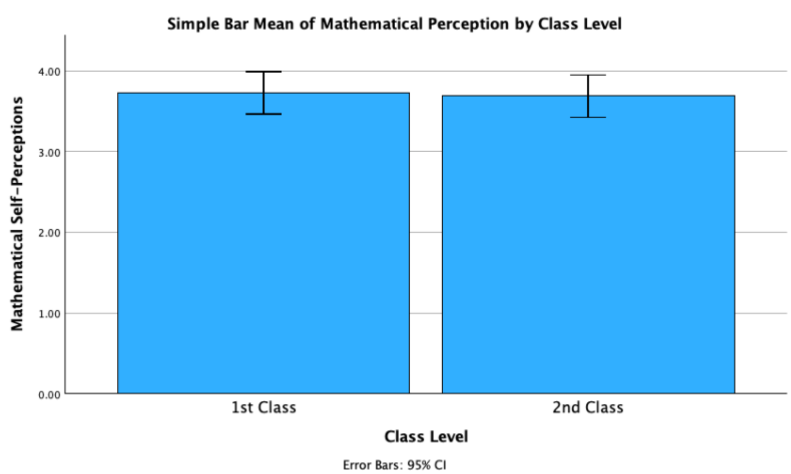
Group Differences in Mathematics Enjoyment (Independent Samples t-tests). Preliminary assumption testing indicated that responses from pupils in first class (M=3.90, SD=0.95) and pupils in second class (M=3.85, SD=0.92) were not normally distributed. Levene's test was non-significant, thus equal variances can be assumed. The t-test was non-significant, $t(85.14)$ =0.21, p=0.833, two-tailed, 95% CI of the mean difference [-0.35, 0.44]. This indicates that pupils in first- and second- classes do not differ in levels of Mathematics enjoyment, as displayed below in Figure 5.

Figure 5.
Mean Mathematics Enjoyment Scores by Class Level



Group Differences in Self-Perceptions (Independent Samples t-tests). Similarly for mathematical self-perceptions, preliminary assumption testing indicated that responses from pupils in first class (*M*=3.73, *SD*=0.84) and pupils in second class (*M*=3.70, *SD*=0.89) were not normally distributed. Again, Levene's test was non-significant, thus equal variances can be assumed. The t-test was non-significant, *t*(0.20) =87, *p*=0.84, two-tailed, 95% CI of the mean difference [-0.33, 0.40]. This also indicates that pupils in first- and second- classes do not experience differences in mathematical self-perceptions, as displayed below in Figure 6.

Figure 6.
Mean Mathematical Self-Perception Scores by Class Level



Relationships between items on Math and Me Survey (Correlation Analysis). To determine the relationships between responses on the Math and Me Survey, some opposite items were chosen for the purpose of conducting correlation analysis. This allowed the researcher to identify the reliability of the responses provided by participants. The correlation of opposite items (e.g. “I understand math” versus “Math is confusing to me”) were assessed using a non-parametric method, Spearman correlation, as the assumptions for Pearson’s correlation (normality and linearity) were violated. Positive correlations were observed between items such as “I am really good at math” and “I understand math”, “I understand Math” and “I can solve Math problems”, “I understand Math” and “Math comes easily to me” and “Math comes easily to me” and “Doing Math is easy for me.” This indicates that there is consistency in pupil responses, in that pupils who feel that they understand Mathematics, also report that they can solve problems and have positive self-perceptions towards Mathematics. When looking at “I can solve math problems” and “Math is confusing to me”, there is a weak correlation, which indicates that as pupils feel more confident in solving problems, they find Mathematics more confusing. While a relationship exists between the two items, it may not be strong enough to predict or conclude the extent to which pupils’ confidence in solving mathematical problems relates to how confusing they find Mathematics. Results are displayed in Table 11 below.

Table 11.
Spearman's Rank-Order Correlation Coefficients and Significance Levels for Mathematical Self-Perceptions

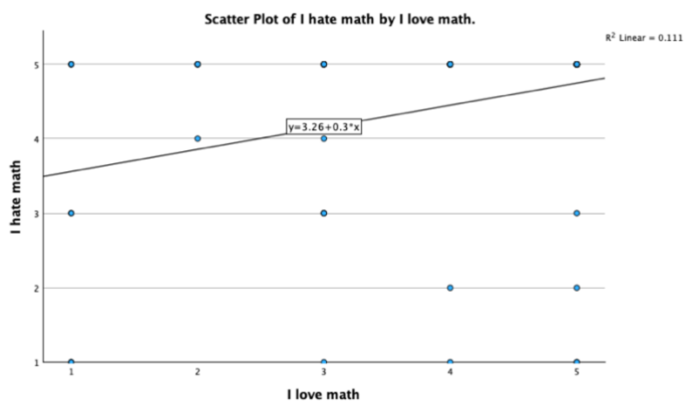
Spearman's RHO **p-value**	**I am really good at Math**	**I understand Math**	**I can solve Math problems**	**Math is very hard for me**	**Math is confusing to me**	**Math comes easily to me**	**I can tell if my answers in Math are correct**	**Doing math is easy for me**
I am really good at Math	-	0.5829 P<0.001*	0.4462 P<0.001*	0.1929 P=0.077	0.1354 P=0.2088	0.4524 P<0.001*	0.2208 P=0.0402	0.4984 P<0.001*
I understand Math		-	0.5402 P<0.001*	0.2486 P=0.0220	0.3693 P<0.001*	0.5451 P<0.001*	0.3348 P<0.001*	0.4864 P<0.001*
I can solve Math problems			-	0.3116	0.2120	0.4055	0.3512	0.4807

	P=0.0036	P=0.0402	P<0.001*	P<0.001*	P<0.001*
Math is very hard for me	-	0.3285 P=0.0014*	0.2986 P=0.004*	0.1880 P=0.0779	0.2281 P=0.0366
Math is confusing to me		-	0.1965 P=0.0616	0.13 P=0.221	0.2169 P=0.418
Math comes easily to me			-	0.3355 P<0.001*	0.5967 P<0.001*
I can tell if my answers in Math are correct				-	0.2950 P=0.0052*
Doing math is easy for me					-

Additionally, scatterplots were used to identify if children consistently replied to negatively phrased items on the measure. An evaluation of scatterplots indicated that children answered "Always" to both "I hate math" and "I love math." This was unexpected as it was expected that children who hated Mathematics would not feel positively towards Mathematics. This indicates that pupil responses on some items may not be reliable. Social desirability may have had an influence on pupil responses, and they may not have wanted to provide a low score for "I love math." This is displayed in Figure 7.

Figure 7.

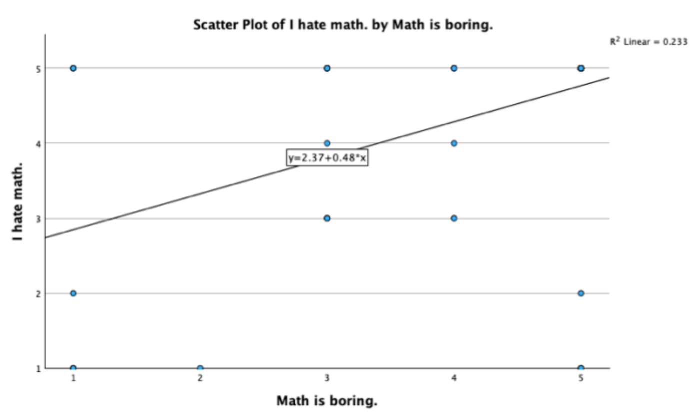
Scatterplot of negatively phrased item responses ("I hate math" and "I love math").



When exploring if children responded in a similar manner to items "I hate math" and "math is boring," scatterplots indicated that these items were positively correlated. This suggests that children who find Mathematics boring also feel negatively towards the subject. This association is portrayed in Figure 8.

Figure 8.

Scatterplot of negatively phrased item responses (I hate math and math is boring).



Class level and Gender were interrogated to see if they predicted mathematical self-perceptions or mathematical enjoyment, however these relationships were not significant. A summary can be found in Tables 12 and 13.

Table 12.
Univariate and Adjusted Linear Regression Analyses Predicting Mathematics Enjoyment (ME) Total Scores by Gender and Class

ME total scores		**Univariated Linear Regression Analysis**		**Adjusted Linear Regression analysis**	
Variable	**t-test p-value**	**Coef (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Gender					
Male (ref)					
Female	0.204	2.82 (-1.55 to 7.20)	0.204	2.81 (-1.59 to 7.22)	0.207
Class					
1st (ref)					
2nd	0.832	-0.42 (-4.35 to 3.51)	0.832	-0.37 (-4.29 to 3.54)	0.848

Table 13.
Univariate and Adjusted Linear Regression Analyses Predicting Mathematical Self-Perceptions (MSP) Total Scores by Gender and Class

MSP total scores		**Univariated Linear Regression Analysis**		**Adjusted Linear Regression analysis**	
Varible	**t-test p-value**	**Coef (95% CI)**	**p-value**	**OR (95% CI)**	**p-value**
Gender					
Male (ref)					
Female	P=0.8811	-0.24 (-3.54 to 3.04)	0.881	-0.25 (-3.56 to 3.06)	0.879

Class					
1st (ref)					
2nd	P=0.8397	-0.29 (-3.22 to 2.63)	0.840	-0.30 (-3.24 to 2.64)	0.839

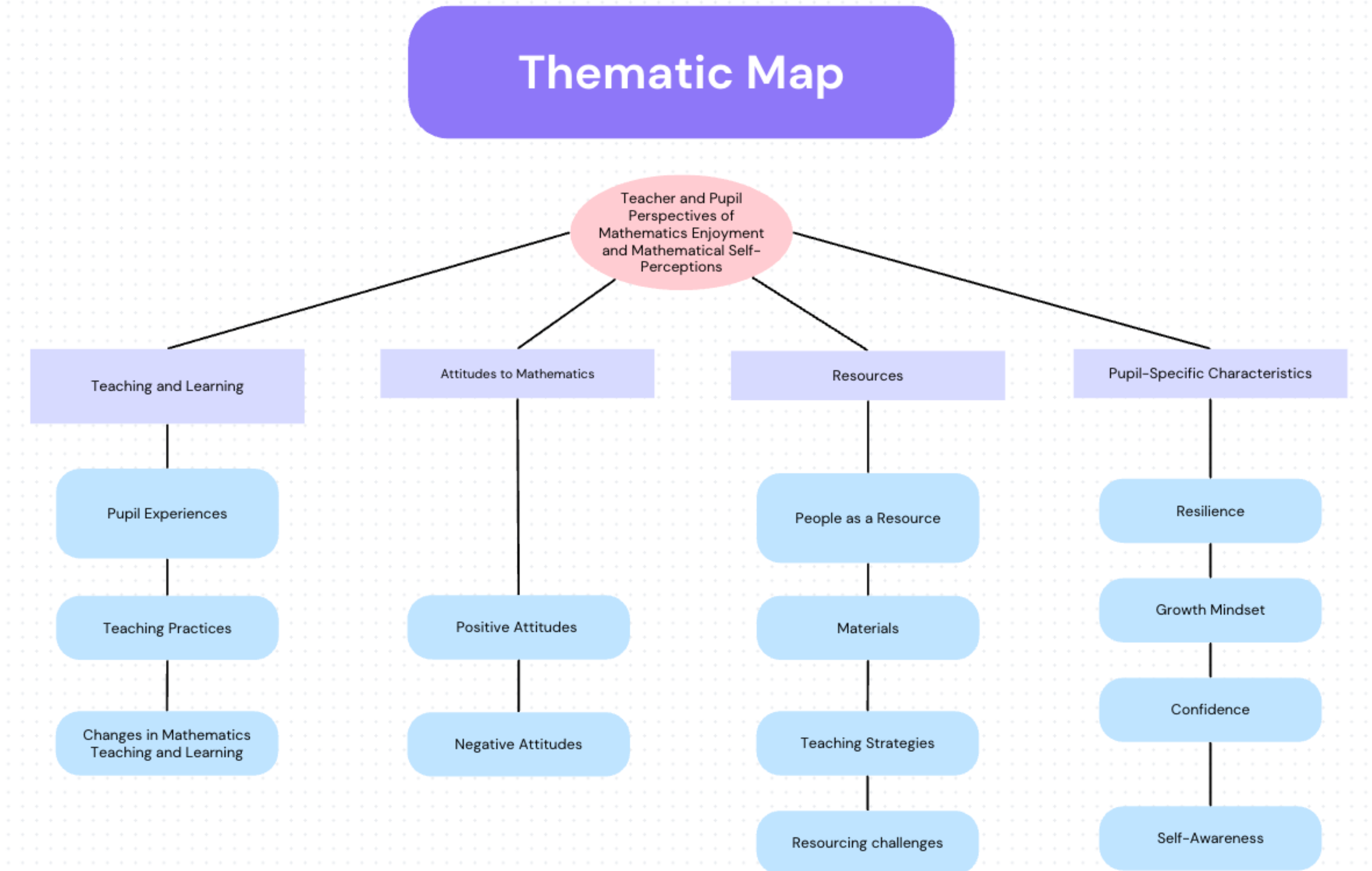
Excerpt from Reflective Journal: Reflecting on these findings, I was struck by the relative consistency in pupils' responses. As a former teacher, I know how children can change and develop as they transition to new classes, and I therefore had anticipated greater variation in their experiences. I was also reminded that due to inconsistencies in responses, gathering self-report data from young children can highlight developmental complexities. As a researcher who has gravitated towards quantitative research in the past, this has brought attention to the importance of triangulating data. As I transition into my role as a psychologist, I have become increasingly aware of the importance of capturing pupil voice and experience, rather than relying solely on psychometric measures.

Qualitative Findings

Reflexive Thematic Analysis (Braun & Clarke, 2006; Braun & Clarke, 2021 was used to analyse the open-ended teacher questionnaire and qualitative data from the Mosaic approach. Teachers and pupils provided insights into their experiences of teaching and learning during Mathematics lessons. These insights were combined, and the six-stage process was followed, using NVivo (Version 14) to analyse the combined data and generate themes. The generated themes and subthemes are detailed below and are displayed in Figure 9.

Figure 9.

Thematic Map displaying Themes and Subthemes generated

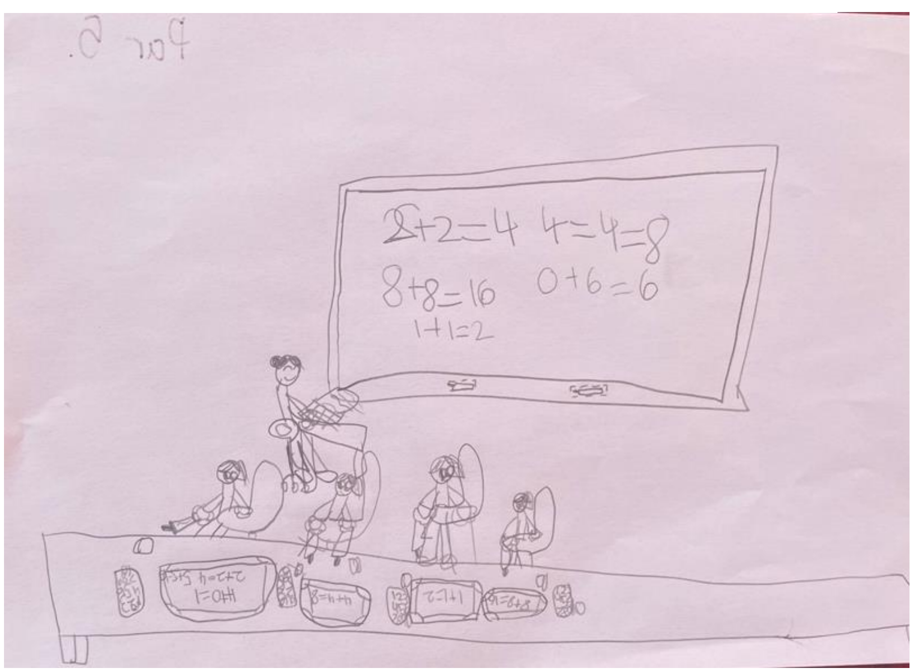


Theme 1: Teaching and Learning. *Sources: Teacher Questionnaire, Mosaic Artefacts (Pupil Drawings and Collages), Pupil Discussion.*

Subtheme 1: Pupil Experiences. This subtheme explores how experiences of pupils are perceived and conceptualised by both teachers and pupils relating to teaching and learning in Mathematics. A strong emphasis on the impact of varied teaching practices and strategies, supportive classroom environments and positive relationships between pupils and their peers and teachers on pupil experiences is examined. This highlights how 'Positive Emotions', 'Engagement' and 'Relationships' are cultivated within optimal learning environments, integrating PERMA (Seligman, 2011) and the Bioecological Model of Human Development, specifically the PPCT model (Bronfenbrenner & Morris, 2006). A safe environment was deemed to be of significance by teachers in encouraging children to embrace their mistakes and reframe them as learning, linking to a growth mindset approach; "I like to have a safe environment for the children where mistakes aren't seen as negatives and allow the opportunity for further learning" (T2). Pupils echoed the importance of the environment, with several participants commenting that they especially enjoyed engaging with station teaching, being exposed to a variety of activities and materials within one lesson. Several pupils noted that their favourite station is when they are working with their class teacher, with one commenting "because she helps us with learning" (P3, SA). This aligned with teacher responses, who noted that pupils appear to enjoy the individual learning time and attention they receive within the smaller group; "They enjoy the special time they get with the teacher, they like the close attention they're getting in the small group" (T6). If this collective experience is viewed through a lens that aligns with Vygotsky, it is possible that the additional scaffolding provided by teachers helps children to feel supported as they build on previous learning and navigate new concepts. This supportive environment allows pupils to take risks, embrace mistakes and engage with challenges, mitigating apprehension of failure. Such psychological safety is an important contributing factor, which enables children to progress beyond their abilities within the Zone of Proximal Development (Vygotsky, 1978). This in turn has the propensity to promote more effective learning, engagement with the curriculum and the capacity for children to boost their confidence. From a PERMA perspective, the importance of the pupil-teacher relationship in promoting wellbeing of pupils aligns with the ‘Relationships’, ‘Engagement’ and ‘Accomplishment’ elements of the framework.

Additionally, pupils discussed enjoying doing Mathematics as a whole class; “it’s funner when everyone joins in…” (P3, SB); “when everyone’s doing it together it’s better” (P1, SA) and noted they enjoyed engaging with their peers “if someone wants you to help them, you can help them” (5, SB); “Teamwork when figuring out Mathematics sums and playing Mathematics games” (P2, SA). This corroborated teacher reports of the value of mixed-ability groupings; “engaged in group activities which appropriately challenge them… allowing everyone to take part” (T2), facilitating collaboration between pupils as they explored new mathematical concepts and applied learned concepts. When the pupils engaged in the Mosaic approach, these aspects of their experiences were evident in their drawings of their favourite lessons, which often showed pupils engaging with peers and teachers in their classrooms, engaging in groupwork or whole class learning. This prompted their discussion of positive learning experiences when engaging with their friends and spending time with their teacher, which contributed to fostering a positive and safe learning environment. A sample drawing from Participant 5, School A depicts this in Figure 10.

Figure 10.
Participant 5 School A depiction of “My Favourite Maths Lesson”



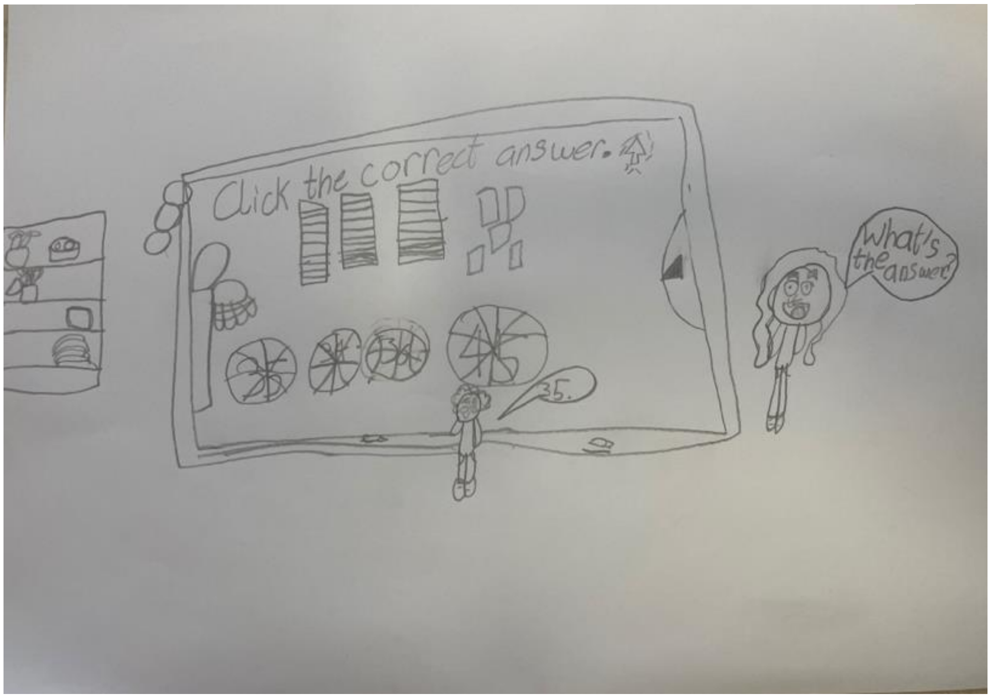
While the dominant narrative from both pupils and teachers discussed mainly positive experiences of Mathematics, a closer examination of the data exposed subtle, yet important tensions which highlighted the diversity and complexity of pupil experiences. These are specifically relevant to gaining an insight into how pupil perceptions may fluctuate over time, which may be impacted by the transition from first to second class. One pupil displayed a sense of ambivalence, simultaneously acknowledging overall enjoyment and detailing feelings of disengagement at times; "Sometimes I just find it boring. 'Cause...like sometimes it can be like you do it too much that it just gets boring… But normally I do like Maths." (P1, SA). The same pupil also described increased difficulty, telling first class pupils "Oh it gets harder, trust me…", indicating that there could be a shift in enjoyment and self-perceptions as pupils transition to second class. He explained that while activities were similar, they had increased in difficulty; "we do the same thing but it's way harder…like you're building on what you did in first class." Another pupil recalled discussing Mathematics homework with a younger sibling, commenting "I told her you are lucky because we have more homework than you. Because when you grow up, you'll have even more, or you have more even more homework than you have right now." (P4, SA). As pupils reflect on increased academic demands, this may be interpreted through Bronfenbrenner and Morris (2006) indicating the developmental impact on the individual. Although these experiences were less prominent among participants, the insights gleaned provide a greater understanding of pupil experiences as tasks become more cognitively demanding and indicating necessity in providing support to pupils emotionally as they navigate curriculum transitions. In addition to supporting their emotional development, it is important to ensure that pupils are exposed to multiple and varied approaches to learning about mathematical concepts. This could potentially mitigate the boredom experienced by participants when they have mastered one approach to a mathematical concept.

<u>Excerpt from Reflective Journal:</u> While PERMA underpinned this study, facilitating a strengths-based approach to understanding the perspectives of pupils and their experiences of Mathematics, children were not deterred from discussing negative experiences or feelings towards Mathematics. Contrary to criticisms of PERMA, which suggest an overemphasis on positive emotions, this openness from pupils indicates that adopting a strengths-based lens does not mean overlooking challenges or difficulty. This emphasises the importance of creating psychologically safe environments in which children can express themselves, something that I will carry with me into my career. This holistic approach aligns with PERMA's broader focus on wellbeing, which encapsulates negative emotions as part of engagement.

Subtheme 2: Teaching Practices. As previously outlined under ‘Pupil Experiences,’ group work and collaboration were key features of Mathematics enjoyment, as reported by both pupils and teachers. This subtheme further explores their conceptualisation and implementation. Gamification and collaboration emerged as dominant strategies utilised by teachers to encourage and bolster pupil participation. Teachers acknowledged the challenges of implementing group work, highlighting the additional time required to establish these routines at the beginning of the school year; “This needs a lot of group work and time in the first term but if successful will help make Maths fun and build confidence with the subject in the children” (T2). This highlights the value placed by teachers on investing time to foster collaboration, and the efficacy of this investment, as pupils grow in confidence and experience Mathematics enjoyment. Pupil reports aligned with this, often referring to group-based games as their favourite aspect of lessons; “it’s better when we do it all together…I don’t like doing it by myself” (P3, SB) and commenting that they like discussing different ways of doing Mathematics with peers “I'd like to chat to other people and see what they think as well...” (P6, SA).

The use of technology was also highlighted from the perspective of enhancing the children’s learning experience. Interactive whiteboards and online games were identified as tools for facilitating active learning. Pupils also emphasised the role of technology in elevating their learning, referring to online games such as TopMarks, and referring to interactive whiteboards as “those boards that are like TV” (P1, SA). Integrating technology and gamification heavily featured among pupils as strategies that boost their enjoyment “It's also fun because we get to like, play Maths games on the board,” (P4, SB); “what we do is teacher like, puts up a nice Maths game,” (P5, SA). This was also depicted in the drawing completed by P2 SB, displayed in Figure 11. As this participant described what they had drawn, they explained their favourite game “Using the whiteboard, because she puts a basketball game on with 10s and units…And like seven 10s and five units…and there's basketballs with wrong answers and the correct answer. And you have to shoot it in then write it on your whiteboard…before she puts the basketball in.” Teachers had indicated that integrating technology into lessons is a priority for them in terms of boosting pupil enjoyment and fostering positive self-perceptions, thus pupil experiences align closely with teachers' intentions.

Figure 11.
Participant 2 School B depiction of "My Favourite Maths Lesson"



The use of concrete materials was highlighted across both data sources as essential for promoting understanding and allowing children to access abstract concepts. One pupil described the process of manipulating toy cars to solve problems; "like with teachers saying what's 3 + 4 and then you have to go 123 and 1234 and then count them all up." (P4, SB). One teacher linked the variety of concrete materials to increased self-assurance, stating "The choice and variety of concrete materials has allowed students to become more confident" (T4). This insight provides evidence for the role of lesson design and material selection in enabling pupils to approach mathematical tasks in a manner which suits their learning style.

When interpreting findings through Bronfenbrenner and Morris's (2006) bioecological lens, it is evident that pupils' experiences of Mathematics are influenced by systems at a classroom-level (microsystem) in addition to a whole-school level. This highlights the salience of school culture and the importance of fostering Mathematics enjoyment and positive self-perceptions in children through repeated and meaningful experiences which have the potential to promote a culture of engaging with and participating in Mathematics. From a PERMA (Seligman, 2011) perspective, when pupils described engaging with games, hands-on activities and utilising technology, positive emotion was evident in the words they selected and their demeanour when discussing these experiences. 'Engagement' and 'Accomplishment' were also portrayed by pupils as they detailed processes involved in their learning involving technology, games and concrete materials. Collectively, these factors contribute to the overall promotion of wellbeing within teaching and learning of Mathematics.

Subtheme 3: Changes in Mathematics Teaching and Learning. A shift towards exploratory learning was evident from teacher descriptions of using problem-solving activities and games. A similar shift was reported by pupils in School A, who described a reduction in completing work from textbooks as they transitioned into second class, commenting that they "we did more book work last year than this year" (P2, SA). Pupils in both schools emphasised the value of using concrete materials to help them, with one pupil commenting that they "find it a little bit easier when you have something that you can hold and touch" (P4, SB) and another stating "sometimes it is a little bit tricky to do things in your head. Sometimes I…use my fingers to help me" (P3, SA). Pupils included concrete materials in their "Maths at my Desk" and "Maths in my Classroom" sections of their collages (as depicted in Figures 12, 13 and 14), when engaging with the Mosaic approach (Clarke & Moss, 2011). This shift towards exploratory learning is embedded in the Redeveloped Mathematics Curriculum, which focuses more on the process of completing Mathematics, facilitating different methods of completing Mathematics tasks and encouraging children to approach problem-solving from different perspectives. It is also of importance to acknowledge that such as shift may also reflect teacher-related qualities, such as differences in teaching style or pedagogical approach. Individual teacher traits such as confidence and experience, coupled with a specific interest in child-centred methods, may result in a classroom climate which naturally subscribes to more exploratory methods, irrespective of curriculum framework.

Figure 12.

Participant 3 School A depiction of "Maths at my desk", "Maths in my Classroom", "Maths in my School" and "Maths Outside".

Figure 13.

Participant 1 School A depiction of "Maths at my desk", "Maths in my Classroom", "Maths in my School" and "Maths Outside".

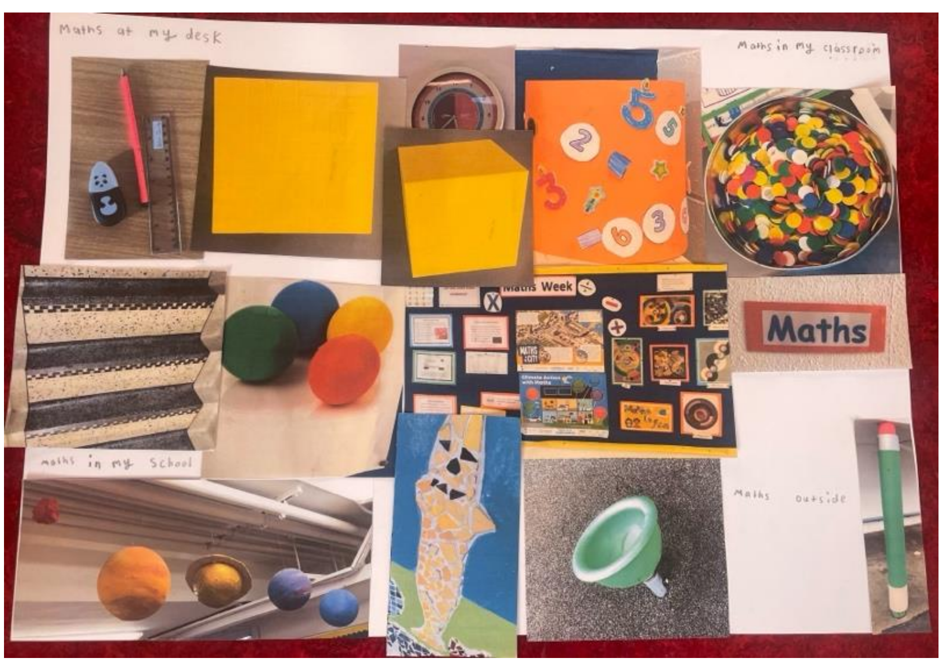
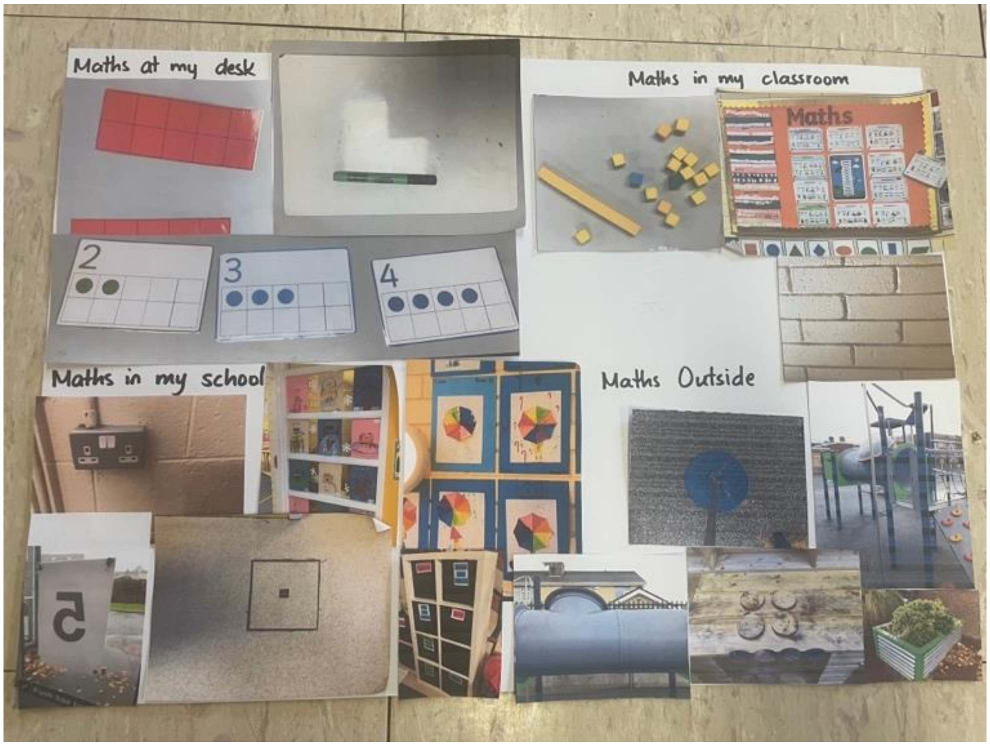


Figure 14.

Participant 4 School B depiction of "Maths at my desk", "Maths in my Classroom", "Maths in my School" and "Maths Outside".



Teachers reported an increase in pupil talk and discussion since receiving training on the Redeveloped Primary Mathematics Curriculum, with one teacher commenting "More child talk and I have started to use the new games and problem solvers from the training day" (T3). Teachers also detailed a shift in the way they approach teaching; "Instead of teaching the methodologies I allow more time for exploration of problems and let students solve them in their own way" (T4). Pupils also mentioned the importance of discussing their processes and problem-solving strategies, with one pupil stating, "it's good to talk about it sometimes" (P1, SB). Implementing learner-centred approaches aligns with the pedagogical shift, conceptualising children as integral to their own learning and capable of engaging in critical thinking skills necessary to participate as opposed to being perceived as passively acquiring procedures. Facilitating more opportunities for pupils to discuss processes could foster a culture which enhances their mathematical self-perceptions and enjoyment by placing merit on their mathematical ideas.

Applying Bronfenbrenner & Morris's (2006) bioecological model to the findings, the change in pedagogy reflects changes in microsystem processes (teaching practices) which have been impacted by macrosystem reform (Redeveloped Mathematics Curriculum). Aspects of Seligman's PERMA framework (2011), 'Engagement', 'Accomplishment' and 'Relationships' are potentially impacted by these changes in pedagogical practice. Collectively, improved Mathematics enjoyment and self-perceptions are likely influenced by the shifts reported by both pupils and teachers.

Excerpt from Reflective Journal: Teachers were asked to participate by principals. It is possible that those with an interest in Mathematics teaching and learning elected to participate. While both pupils and teachers reported positive changes in pedagogical practice, is this down to the interest of the participating teachers? Practices were all portrayed in a positive light, and I wonder if social desirability played a role, despite the anonymous nature of the research. Reflecting on this, I wonder how future research might incorporate a wider range of experiences, including teacher perspectives which may be more critical or ambivalent in nature.

Theme 2: Attitudes to Mathematics.

Subtheme 1: Positive Attitudes. A shared theme of positive attitudes towards Mathematics across pupil and teacher data was generated during Reflexive Thematic Analysis. Teachers detailed a notable shift in pupils' confidence and engagement with mathematical content since the implementation of the Redeveloped Primary Mathematics Curriculum, noting a decline in negative comments; "I don't hear any moans when it's time for Mathematics" (T6). Teachers highlighted the importance of established practices, especially the use of praise and creating safe environments to allow children to share ideas and take intellectual risks. Teacher 4 reflected "I can see satisfaction from the pupils as they realise their own abilities," which emphasises growth in competence beliefs as content becomes more challenging. This is corroborated by pupils, who expressed enthusiasm for the sense of achievement when building on prior knowledge; "I like if you figure out the Maths and then it was right, we'd still keep it in our head…like we remember it" (P5, SB) which indicates that pupils are engaging in active consolidation of their learning. This emerging sense of accomplishment, confidence and engagement aligns with the PERMA framework (Seligman, 2011), specifically the areas of 'Positive Emotion', 'Engagement' and 'Accomplishment'. While teachers acknowledged it is potentially too early to identify if the Redeveloped Primary

Mathematics Curriculum is promoting more positive learning experiences for pupils, in cultivating Mathematics enjoyment and enhancing self-perceptions, it is possible that the curriculum is enabling schools to create a culture which is conducive to developing these constructs.

Teachers emphasised the role of promoting effort over outcomes, with Teacher 6 reflecting "all answers are good, don't be afraid to try, reward and praise participation." This highlights the shift towards focusing on mathematical processes and exploring mathematical concepts from several different perspectives. Echoing teachers' emphasis on effort, Participant 3 (School B) stated that if they were unsure of how to approach a mathematical activity, they would "give it a go," further indicating the classroom culture of framing challenges as opportunities for learning. These findings align with Bronfenbrenner and Morris's (2006) PPCT model, identifying how consistency in classroom interactions, which are considered proximal processes, within encouraging microsystems can create opportunities for positive developmental results.

When pupils engaged with the Mosaic approach (Clarke & Moss, 2011), drawing their favourite Mathematics lessons, they depicted positive portrayals. The people in their drawings, including teachers and pupils alike conveyed positive facial expressions. Each of the people in the drawings were smiling, as portrayed in Figure 15, 16 and 17.

Figure 15.

Participant 2 School A depiction of "My Favourite Maths Lesson"

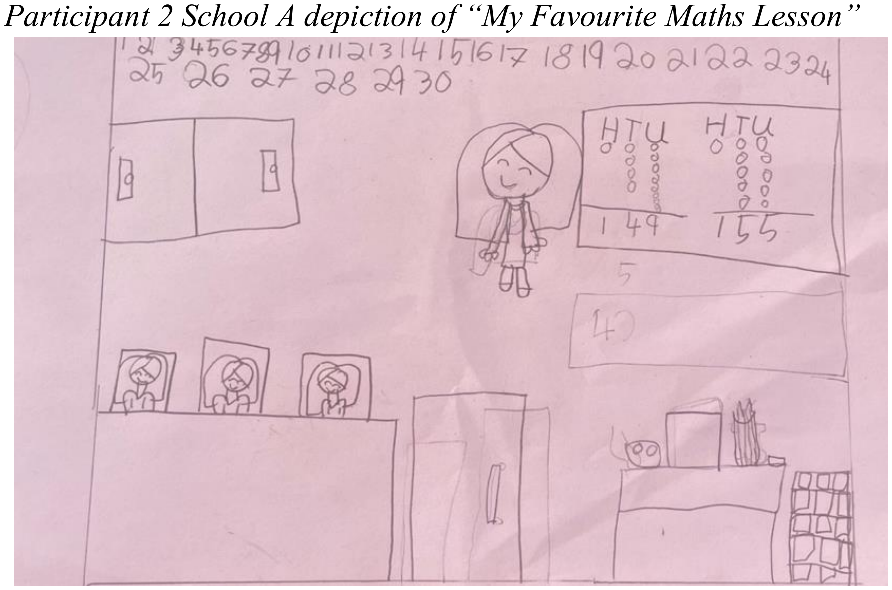
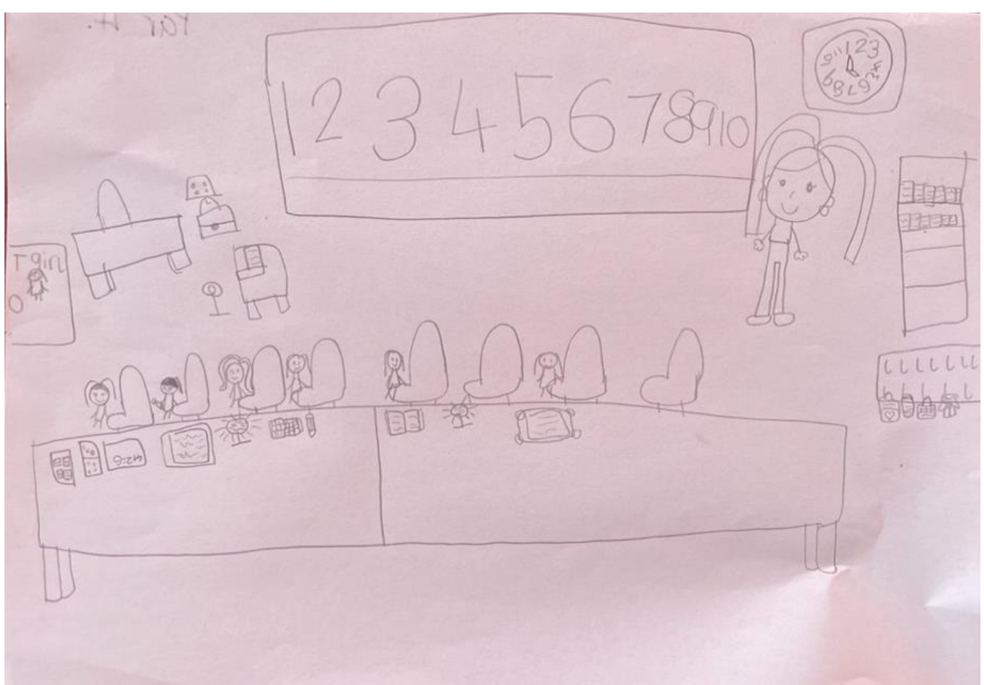


Figure 16.
Participant 6 School A depiction of "My Favourite Maths Lesson"

Figure 17.
Participant 4 School A depiction of "My Favourite Maths Lesson"



Subtheme 2: Negative Attitudes. While most attitudes reported towards Mathematics were positive, a small number of negative sentiments were shared by pupils. Some pupils expressed discomfort in completing tasks or activities independently, articulating a preference for collaborative or whole-class, teacher-led activities. Participant 3 (School B) disclosed that they disliked being “told” what to do and commented that they find Mathematics more engaging and meaningful when choice and autonomy were featured. Some feelings of apprehension were reported with some pupils discussing encountering novel mathematical concepts; “especially if it’s something new, we might not know how to do it” (P2, SA). This tentative apprehension aligns with typical challenges of confronting new information which can often be experienced during periods of transition. Addressing this apprehension through targeted support and appropriate scaffolding has the potential to enhance pupils’ self-efficacy, strengthen their intrinsic motivation, and preserve their self-esteem, fostering resilience in approaching new mathematical concepts.

Challenges relating to workload were also reported with pupils commenting on the increased burden of homework; “I told her you are lucky because we have more homework than you…” (P2, SA) and the monotony of repetitive tasks; “Sometimes I just find it boring… 'cause… like sometimes it can be like you do it too much that just gets boring” (P1, SB). Of interest, one second class pupil commented that they felt “braver” during Mathematics lessons in first class, which may indicate a change in perceived competence as demands increase with class progression.

Teachers did not report negative attitudes in pupils and focused on positive experiences of pupils. Relatively few negative attitudes emerged across the dataset, which may be indicative of strong microsystem supports as defined by Bronfenbrenner and Morris (2006), specifically the positive classroom environment and focus on praise. Taking a strengths-based approach to Mathematics lessons likely contributes to developing and maintaining positive emotion and engagement, which are central to the PERMA framework (Seligman, 2011). As Subtheme 1 (Pupil Experiences) detailed positive experiences because of engaging materials, engagement with teachers and peers, it is possible that these combat negativity by instilling competence and confidence in pupils.

These isolated negative attitudes portray the capacity for pupils to experience different emotions in a fluid manner, and when framed in positive classroom cultures, can coexist with positive attitudes towards Mathematics.

Theme 3: Resources

Subtheme 1: People as a Resource. Taking into consideration both teacher and pupil responses, the significance of people, inclusive of teachers, peers and family, as a key resource was generated as a theme. Throughout the data collection process, the role of the teacher was regularly emphasised among pupils, with Participant 2 (School B) explaining, "my teacher helps me pick what to use, like cubes or the number line, if I'm stuck." Children represented their teacher in a positive light in their drawings, usually as a key dimension, highlighting the salience of teacher-pupil relations in their mathematical engagement. Teachers acknowledged pupils' preference for "the special time they get with the teacher" (T6), which underscores their understanding of the role of teacher-pupil relationships in promoting positive mathematical learning experiences.

Peer collaboration was identified as a key factor contributing to their competence beliefs and sense of belonging within the classroom environment, with pupils detailing instances of helping classmates when finished early; "I like when we help each other if we finish quick" (P5, SA). It is possible that these opportunities for collaboration provide a sense of purpose to children within the classroom climate. Teachers also identified collaboration as a key element of importance, with several teachers naming groupwork as a central aspect to Mathematics lessons (Participant 2, 3, 5, 6). Collectively, these findings indicate the social nature of learning Mathematics in primary school.

Mathematics in the home environment was also mentioned by pupils, as they described Mathematics in their everyday life. Pupils recalled memories of parents assisting them with counting money; "because it's a little bit hard for me to count like

€50, but my parents help me with that" (P4, SA), or "weighing out the ingredients for cheesecake with my Nanny" (P3, SB). This suggests that the home environment reinforces the skill that pupils have used in the school environment, further highlighting the role of microsystems in creating positive attitudes towards Mathematics. (Bronfenbrenner & Morris, 2006) as Mathematics is embedded in their everyday family life. These findings align with the 'Relationships' and 'Meaning' elements of PERMA (Seligman, 2011), suggesting that interpersonal interactions that are supportive and meaningful in nature, are essential to the development of positive mathematical experiences of pupils.

Subtheme 2: Materials. As previously mentioned, when describing pupil experiences in Theme 1, the value of resources in enhancing Mathematics enjoyment was heavily represented throughout the data collected for both pupils and teachers. Concrete materials were consistently referred to by pupils as enabling them to engage with mathematical concepts, such as cubes, counters, dominoes, Diens blocks, number lines and individual whiteboards. These were heavily represented in the collages created by pupils, as displayed in Figure 18 below. Participant 1 (School A) explained "I like using the cubes because you can see the numbers better," indicating that abstract mathematical concepts were more accessible to pupils when represented in a concrete manner. This reinforces the 'Engagement' element of PERMA (Seligman, 2011) as pupils' engagement in mathematical tasks is improved when concrete materials are available to them. Similarly, teachers indicated that pupils responded well to having choice relating to the materials available to them. They noted that pupils' confidence was strengthened and approaches to problem-solving enhanced when they had access to a variety of resources; "giving them the choice of materials empowers them- they pick what helps them figure it out best" (P4). This ensures equity among pupils in terms of resources, enabling them to engage with mathematical learning at their own pace.

Technology also featured as a key resource, with pupils emphatically describing the use of iPads and Interactive Whiteboards for games and whole-class activities, describing their integration into lessons as "the best Maths" (P6, SB). Teachers supported this, commenting that this type of learning was popular with children, cultivating enjoyment and further motivating children to participate in lessons, which align with 'Positive Emotion' and 'Engagement' elements of the PERMA framework (Seligman, 2011).

Figure 18.
Participant 3 School B depiction of "Maths at my desk", "Maths in my Classroom", "Maths in my School" and "Maths Outside".

Subtheme 3: Teaching Strategies. Teachers highlighted how their pedagogical approaches to teaching Mathematics had been altered following the implementation of the Redeveloped Mathematics Curriculum (2023), describing the shift towards exploratory learning and a focus on process and strategies; "They participate more and are starting to explain the methods used or how they got their answer." (T3). An emphasis on group work and mixed ability grouping in place of traditional ability grouping was reported, with Teacher 2 stating "learning happens best when the children aren't necessarily aware of it but engaged in group activities which appropriately challenge them," which highlights the subtle nature of imparting mathematical knowledge within a group context.

Teachers emphasised real-world connections, describing the necessity of making Mathematics applicable to children's daily lives, particularly in creating meaningful and relatable contexts, which aligns with the 'Meaning' and 'Accomplishment' in the PERMA framework (Seligman, 2011). Differentiation featured as a foundational concept in ensuring that all pupils could access learning in addition to feeling challenged.

Of significance, teachers consistently reported a shift from more instructional teaching styles to exploratory, pupil-led approaches which cultivated confidence and enjoyment for pupils. Teacher 3 reflected "We support them to try different ways of solving problems -whichever way makes sense to them." This is reflective of Bronfenbrenner and Morris's (2006) focus on proximal processes as essential to the cognitive and emotional development of pupils.

Subtheme 4: Resourcing Challenges. While both teachers and pupils reported positive narratives, structural challenges were identified across both sets of data. These structural challenges impacted resource use and the provision of support. Teachers highlighted the pressure arising from staffing shortages, with one commenting "the level of support we can give to Mathematics has decreased due to lower teacher numbers, but the principles we learned still remain" (T2), while another expressed desire for protected time to dedicate to planning lessons and familiarising themselves with the Redeveloped Primary Mathematics Curriculum. Pupils echoed the staffing shortages and acknowledged the changes in their support structure, describing the reduction in SNA support and the turnover of teachers. Participant 5 (School A) commented "we used to have a helper but now it's just our teacher" and "Ms. F went to a different school…she's the principal" (P4, SB). This suggests that pupils are aware of the changes within their learning ecosystem and school environment.

From a Bronfenbrenner and Morris (2006) perspective, these disruptions to the microsystem and exosystem may have an impact on pupils' learning experiences. While these disruptions are prevalent in Irish classrooms, the emphasis placed on relational support and pupil autonomy appear to combat these disruptions, promoting resilience in pupils and sustaining overall positive attitudes towards Mathematics. This resilience aligns with the ‘Positive Emotion’, ‘Relationships’ and ‘Meaning’ elements of PERMA (Seligman, 2011).

Theme 4: Pupil-Specific Characteristics

Subtheme 1: Resilience and Growth Mindset. Teacher and pupil data indicate that resilience was a common factor in enabling children to approach mathematical challenges. Pupils detailed a variety of strategies for overcoming difficulty, including coping strategies such as positive self-talk and breathwork. Participant 4 (School B) reported “when I struggle, when there’s just lots of things to do in math. I take a breath and then I just do it,” indicating their capacity to engage in self-regulation skills. Self-regulation skills are essential for engaging in effective proximal processes (Bronfenbrenner & Morris, 2006). These skills allow children to build resilience by overcoming challenges in learning, which ultimately contributes to their overall development. Teachers substantiated these observations, highlighting the tenacity present in pupils, which they used to persevere when challenges were presented; “some tasks are more challenging, and children experience enjoyment at succeeding in these activities” (T2). Teachers also highlighted their expectation for children to view mistakes as opportunities for growth; “mistakes aren’t seen as negatives and allow the opportunity for further learning” (T1). This was echoed by pupils who acknowledged the emphasis placed by teachers on effort rather than precision, with one pupil commenting “our teacher will be like…it doesn’t matter if you get anything wrong as long as you put 100% into it” (P1, SB). This concept is incorporated into the PERMA framework (Seligman, 2011), where persevering is celebrated in addition to outcomes in ‘Engagement’, ‘Positive Emotions’ and ‘Achievement’.

Closely linked with resilience was the emergence of a growth mindset among pupils. This was corroborated by teachers who commented on the growth and satisfaction they observed from pupils when they realised their abilities. An emphasis was placed on improving mathematical ability with effort and experience, with pupils considering both success and failure to contribute to the process of learning. One pupil provided an insight into their conceptualisation of mistakes, explaining

> "If you get it wrong you should be happy if you get it wrong. But if you get it right, you should be happier…Cause if you get it wrong, you could learn from your mistakes and if you get it right, you already knew you learned from your mistake" (P3, SB).

Pupils also detailed their views of the impact of experience on ability, as they commented that Mathematics becomes easier as they progress through different class levels, linking this to accumulation of consolidated knowledge. This aligns with Bronfenbrenner and Morris's (2006) Bioecological theory from a developmental perspective, which focuses on the necessity of enhanced complexity within tasks to enable pupils to experience growth. Participant 1 (School A) described mixing up numbers but then independently correcting mistakes by referring to visual supports in the classroom, explaining, "I just match them to the numbers on the wall and change it." This indicates the support provided by teachers; in providing resources to all pupils and allowing them to determine which support they require to complete tasks, promoting internalisation of learning strategies which cultivates self-efficacy and resilience.

Subtheme 3: Confidence. Both pupils and teachers reported increases in confidence, with teachers indicating that pupils displayed greater satisfaction and self-assurance having persisted through mathematical challenges. One teacher commented that these experiences of success bolster their confidence and lead to increased engagement with the subject; "they have definitely become more confident in their ability and therefore are more engaged throughout the lesson," (T3), while another teacher commented on how the pupils' increased confidence had resulted in greater enjoyment in the subject, "more confidence which means they enjoy Maths more" (T4).

As previously mentioned, the importance of concrete materials with the implementation of the Redeveloped Primary Mathematics Curriculum and play-based pedagogy throughout all class levels was emphasised. It is possible that representing concepts visually at all class levels allows for deepened understanding of core mathematical concepts, and this in turn allows children to have renewed confidence when they are providing answers or discussing their processes. Pupil discussion highlighted practices and resources such as using individual whiteboards, which they felt enhanced their confidence. They reported that sharing their work with the class may feel daunting at first, but this was framed as an overall positive rather than as a risk, with Participant 3 (School B) stating, "sometimes you think you're not going to do it…and then you actually do do it." Findings align with the 'Accomplishment' and 'Engagement'' elements of PERMA (Seligman, 2011), where experiences of success built from challenges reinforce the child's positive self-perceptions and ultimately strengthen their confidence.

Additionally, peer support and teacher encouragement were identified as significant in terms of the role of relationships in building pupils' confidence. This highlights the influence of Bronfenbrenner and Morris's (2006) microsystem. A classroom climate that promoted bravery and risk-taking enabled pupils to develop competence beliefs, and this was underpinned by encouragement from teachers who praised effort.

Subtheme 4: Self-Awareness. Lastly, pupils' self-awareness regarding their mathematical learning journey was a theme which provided insight into their metacognitive abilities. Pupils provided insights into their strengths; "my best thing in Maths is counting… I know all my doubles too" (P6, SA), areas requiring support; "we do harder things…with fractions last year, this year they'll be way harder, like you're building on what you did in first class" (P1, SB), and the learning processes they engage with to overcome challenges encountered. They compared their experiences tentatively to experiences in previous classes, with second class pupils recalling their experiences in first class; "it was a bit more easy… it's easier to do the Maths in first class" (P3, SB) and first class pupils finding it challenging to remember Mathematics lessons, often detailing Literacy Lift Off experiences, which may suggest their Mathematics experiences were enmeshed with play to the extent that the pupils did not differentiate between the two. It is also reflective of their developmental stage, perceiving their interactions and learning as fluid in nature, rather than fragmented experiences.

In School B, pupils discussed the importance of mastery and framed boredom within this process, with Participant 3 stating "when it gets boring, it means you're getting better at it." This revealed a subtle understanding that to acquire a skill, practice is required. This reframing of boredom aligns with the growth mindset mentioned in Theme 3, as pupils interpret their mathematical ability not as something that is innate or fixed, but as something that can improve and develop with practice. These metacognitive reflections highlight the capacity for children to find meaning in their progression and acknowledge that progress and development as they advance through school. These reflections align with the 'Meaning' and 'Accomplishment' elements of the PERMA model (Seligman, 2011).

Reflective Journal Excerpt: Pupils self-selected to participate in the Mosaic Approach element of the research. As such, it is possible that pupils who experience negative attitudes towards Mathematics, demonstrate low confidence and have a fixed mindset, did not wish to participate in this part of the research. The participating children demonstrated predominantly positive attitudes towards Mathematics and portrayed a growth mindset when discussing challenges. This limits the diversity of responses received. Reflecting on this, there is a need to find a way to empower all pupils, including those who may feel less confident to share their authentic experiences. Looking to the future as an educational psychologist, I recognise the importance of creating trusting and supportive relationships that encourage children to remain open about their strengths and struggles. It has reminded me that effective support goes beyond academic performance and requires a holistic approach to the child's wellbeing.

Summary. Taking quantitative and qualitative findings into consideration, the analyses provide valuable insights into teacher and pupil perspectives on mathematical self-perceptions and enjoyment in the context of the Redeveloped Mathematics Curriculum. These findings set the stage for further discussion regarding the patterns which were generated during Reflexive Thematic Analysis, alongside pupil responses on the Math and Me Survey (Adelson & McCoach, 2011).

Discussion

Overview of Findings

This study employed a mixed-methods approach to explore potential differences in mathematical self-perceptions and enjoyment between first- and second- class pupils, and to investigate if the Redeveloped Mathematics Curriculum (2023) has an impact on these experiences.

Interpretation of Findings

Research Question 1. This study explored if there was a difference in self-perceptions in first- and second- class pupils. A mixed methods approach was taken to gain insights into how pupils view their own mathematical abilities, and if the transition impacts these views. As previously reported, no significant differences were found in mathematical self-perceptions of first- and second- class pupils. This indicates that transitioning into first class does not appear to impact pupils' beliefs regarding their mathematical competence. This contrasts with other literature in the area which indicates that transitions, particularly in upper primary, impact self-perceptions of pupils, and they experience a decline in self-concept (Evans et al., 2018; Arens et al. 2013), which suggests that lower primary may constitute a psychologically stable period where self-perceptions of pupils are protected and maintained. It is possible that demands during the lower primary years are sufficiently low to protect the positive mathematical self-perceptions of pupils. This is specifically relevant to the 'Time' element of the PPCT model (Bronfenbrenner & Morris, 2006), with pupils in junior primary school years experiencing a developmentally stable period, where positive competence beliefs are maintained.

While no differences between class levels were found in quantitative data analysis, qualitative analysis generated several central themes, evidencing strength-based mathematical self-perceptions, where pupils identified themselves as capable and resourceful learners. Teachers reported the salience of praise and encouragement and highlighted the growth in confidence they have observed in their pupils. This emphasises their pivotal role in nurturing positive self-perceptions. This aligns with previous research which indicated that positive comments from teachers in the form of praise, support and other interactions resulted in positive emotions in primary school pupils (Ni, 2025). Their encouragement provided a lens for pupils to view mistakes as part of the learning process, which mirrors proximal processes put forward by Bronfenbrenner and Morris (2006). Pupils internalised this way of framing mistakes, and expressed continued motivation and pride in their effort, irrespective of outcome. Pupils presented with resilience, a growth mindset, metacognitive self-awareness relating to their ability, and approached tasks and challenges with a positive attitude, framing them as learning opportunities. This is reflective of the 'Person' dimension of the PPCT model (Bronfenbrenner & Morris, 2006), encapsulating person-specific characteristics such as motivation, beliefs and dispositions that are enmeshed with context and process. Growth mindset has been utilised as a tool to improve attainments in pupils, whilst acknowledging the role of positive self-perceptions and a sense of belonging (Morgan et al., 2024). The use of tangible resources such as technology and concrete materials, alongside the variety of activities during station teaching exposes children to activities that they can successfully complete, fostering a sense of achievement and strengthening positive self-perceptions. The use of concrete materials has been highlighted as being beneficial in terms of enhancing pupils' Mathematics education (Lafay et al., 2019), whilst utilising ICT tools has improved outcomes for primary school pupils in Mathematics (Zaranis, 2018). This aligns with the 'Context' element in the PPCT model, which highlights aspects of the environment which can enhance learning and pupil development.

At this stage of their learning, it is possible that pupils may not yet experience pressure relating to their learning that can emerge later in pupils' learning journey, which could potentially impact self-perceptions. While the findings of this research project suggest no immediate change in mathematical self-perceptions during the transition from first to second class, it is important to focus attention on the importance of building and maintaining confidence and resilience in young children. Self-perceptions are associated with achievement success and lasting engagement in Mathematics (Shone et al., 2023), thus strategies to promote positive mathematical self-perceptions should be considered throughout primary school. Importantly, this study extends the literature by illuminating how teacher-pupil relationships and learning environments serve as essential psychological contexts, which are central to the 'Context' component of PPCT (Bronfenbrenner & Morris, 2006). Findings suggest that self-perception is not defined by ability or achievement but is impacted by the quality of relational and emotional climate, which reflects the 'Process' element of PPCT (Bronfenbrenner & Morris, 2006), where developmental outcomes are determined by reciprocal interactions between pupils and their environments over time.

Research Question 2. This study sought to explore if there is a difference in enjoyment of Mathematics between first- and second- classes. Quantitative data findings indicated no significant difference in Mathematics enjoyment between first- and second-class pupils, which indicates that at this educational stage, the transition between class levels does not significantly influence affective responses of pupils. This is a novel finding in the Irish primary context and provides a deviation from international trends, as previous literature in the area has found that as pupils progress through school, they develop increased negative attitudes towards Mathematics, due to higher demands within the subject and less experienced enjoyment (Russo et al., 2023). It is possible that this decline may become apparent in middle and senior classes rather than the lower end of primary school. A key contribution of this study is the acknowledgement of the role of the microsystem (Bronfenbrenner & Morris, 2006) in junior primary classrooms, which indicates that learning design and environmental stability may act as protective factors, which preserve pupil enjoyment as they navigate early transitions. Framing these findings using Bronfenbrenner and Morris's (2006) PPCT model, the 'Process' dimension indicates the role of pedagogy, such as play-based learning in Mathematics and positive teacher-pupil relationships in nurturing pupil interactions within their environment. The 'Time' component suggests that the impact of transitions may emerge during upper primary school classes, when curricular demands and potential alterations to pedagogy could impact pupil enjoyment and motivation.

Although quantitative findings indicated no significant difference in Mathematics enjoyment of pupils in first- and second- classes, qualitative findings indicated several factors impact Mathematics enjoyment, irrespective of class level. Mathematics enjoyment was associated with engaging tasks such as games, puzzles and hands-on tasks with real-life applications. This aligns with the 'Engagement' and 'Positive Emotion' elements of PERMA (Seligman, 2011), and map meaningfully onto the 'Process' component of Bronfenbrenner and Morris's (2006) PPCT model, which highlights the salience of reciprocal interactions between pupil and environment, preserved over time. The use of these tools was regularly mentioned throughout, as a key component of sustaining pupil engagement during lessons. Teachers reported increased participation and confidence, which contributed to cultivating positive attitudes towards Mathematics. Pupils offered insights into their preferred methods of learning, such as engaging with stations, working with their class teacher in small groups, and engaging with their peers in group tasks. This aligns with previous literature, which identifies the use of concrete materials as essential in promoting mathematical reasoning, problem-solving and encouraging engagement in lessons (Tjandra, 2023; Ahmad & Siller, 2024). These preferences align with the 'Person' element of the PPCT model, identifying the individual characteristics of pupils which may impact pupil experiences of Mathematics learning.

Pupils displayed attitudes of resilience and growth mindset relating to Mathematics challenges, with pupils reporting that finding Mathematics challenging would not impact their enjoyment of the subject. Pupils viewed mistakes as learning opportunities and highlighted the importance of embracing these opportunities to improve their mathematical experience. This corroborates Bronfenbrenner and Morris's (2006) PPCT model, specifically the 'Process' element, which underscores developmental potential as a product of reciprocal interaction and challenge, and aligns with PERMA (Seligman, 2011) 'Accomplishment' component, indicating that pupils identified intrinsic value in persevering through challenges encountered. They reported positive attitudes towards challenges, noting that their teachers encourage them to approach the challenges with their best effort. This aligns with the 'Context' element of PPCT, where the culture within the classroom, in terms of pedagogy and emotional support, endorses resilience. Resilience among pupils has been identified as essential in promoting psychological wellbeing and engagement, highlighting the positive impact having a growth mindset can have on both academic success and psychological wellbeing of pupils (Zeng et al., 2016). Teachers noted that pupils are benefitting from a reduction in prescriptive, instructional teaching methods, instead figuring out different ways to approach a problem themselves. This is reflective of a shift in pedagogical practice, which aligns with the ‘Time’ element of PPCT, which is impacting pupil attitudes over time.

As no significant difference was reported between the two classes, several possible explanations emerge. Within each school context, it is possible that consistency is applied to teaching methods, and pupils receive continuity in their Mathematics learning experience, which could limit a potential change in Mathematics enjoyment. A lack of continuity has been explored as a barrier to mathematical success and engagement, particularly at transitions from primary to secondary school (Cantley et al., 2020). This underscores the significance of coherence in pedagogical implementation, which is embedded in the PPCT model dimension ‘Context’ (Bronfenbrenner & Morris, 2006), highlighting the potential for the mesosystem to promote and maintain positive attitudes among pupils. Consistent approaches in primary school may facilitate greater engagement and success which likely contribute to Mathematics enjoyment of pupils. From a PERMA perspective, ‘Positive Emotions’ towards Mathematics are cultivated by a predictable and supportive environment, which enable pupils to feel secure, promoting more engagement with the subject and encouraging risk-taking in approaching mathematical tasks.

As children progress through primary school, demands of the curriculum increase and become more complex. It is possible that the demands are not yet at a level that hinders the enjoyment of first- and second- class pupils, as they approach challenges with an open attitude, and an enjoyment of the process involved in figuring problems out. This aligns with the ‘Process’ element of the PPCT model (Bronfenbrenner & Morris, 2006), emphasising the importance of reciprocal interactions between pupils and their environments. It is probable that as the complexity of the problems increase, pupils may experience less success in figuring out the answers and experience a decline in enjoyment and motivation as a result (Mata et al., 2022; Turner & Meyer, 2009). This encompasses the ‘Time’ element of the PPCT model (Bronfenbrenner & Morris, 2006), which demonstrates how changes over time can alter the reciprocal interactions. Additionally, pupils’ perceptions of what constitutes Mathematics can impact the effort exerted, and therefore the enjoyment experienced whilst engaging with the subject (Di Martino, 2019). The ‘Person’ element of the PPCT model (Bronfenbrenner & Morris, 2006) is relevant to this finding, as pupils’ perception of Mathematics, which is impacted by their previous experiences, peer interactions and teacher practices, has a direct impact on how they engage with Mathematics.

The DEIS context of both participating schools is a noteworthy feature of this study. DEIS schools benefit from specific supports that promote inclusive, engaging teaching practices and stronger home-school links. Teachers in these settings may be more attuned to the need for fostering positive attitudes toward mathematics, particularly among pupils who may not have strong academic self-concepts. The findings from this study, particularly the positive pupil engagement, may in part reflect the strengths-focused, relational pedagogy supported within DEIS settings. However, these contextual features may also limit generalisability to non-DEIS schools and should be considered when interpreting the results.

Although the findings imply that there is no significant impact on Mathematics enjoyment as a result of the transition in junior primary years, it is important to accentuate the salience of maintaining current practices and strategies which promote positive attitudes towards Mathematics and bolster pupil enjoyment relating to the subject. Additionally, continuing to utilise resources such as technology and concrete materials would be beneficial in sustaining enjoyment in Mathematics. Future research could focus on later primary school years to explore if Mathematics enjoyment declines when demands increase for pupils.

It is important to acknowledge that the gender distribution in the sample was uneven, with 72% of participants identifying as female. This imbalance is potentially attributed to the single-sex nature of one participating school. As a result, the findings, particularly those relating to gender differences in mathematical self-perceptions or enjoyment, should be interpreted with caution. This overrepresentation of girls may have influenced overall trends in mathematical self-perceptions and enjoyment. While the literature consistently reports a confidence gap in mathematics, with girls often underestimating their abilities despite comparable achievement (Falco et al., 2010; Raabe et al., 2024), this was not a prominent feature in the current study. This may reflect developmental stage, sample-specific factors, or the impact of play-based, inclusive approaches promoted by the Redeveloped Mathematics curriculum. However, the imbalance limits the generalisability of findings, particularly in relation to gender comparisons, and should be addressed in future research.

To conclude, this chapter has explored findings from the research, inclusive of perspectives from both pupils and teachers relating to mathematical self-perceptions and enjoyment in the context of the Redeveloped Mathematics Curriculum in Ireland. Findings indicate that pupils generally sustain positive attitudes towards Mathematics, with factors such as teaching practices, resources and individual traits impacting their mathematical self-perceptions and enjoyment. There were no significant differences in pupil self-perception or enjoyment of Mathematics between the two cohorts. This indicates that the transition from infant classrooms does not have an immediate impact on children's attitudes towards or experiences of Mathematics. Qualitative insights provide greater depth to the exploration of these constructs, and highlight the importance of resources, individual characteristics, learning experiences and practices within the classroom, in defining pupils' mathematical experiences. Comparisons between teacher and pupil perspectives portrayed similar experiences which indicate that pupils and teachers have similar perspectives on the experiences of pupils relating to Mathematics. These findings are relevant when considering implications for future professional practice within schools and ensuring that the Redeveloped Mathematics Curriculum is effectively implemented. This is essential in maintaining positive affect relating to Mathematics, nurturing the resilience of young learners and enhancing the mathematical self-perceptions and enjoyment as they advance through primary school. Tools such as effective curriculum implementation, teaching strategies, and harnessing pupils' individual strengths and characteristics can be intertwined to create a mathematical experience that is enriched from lower primary contexts, promoting confidence, enjoyment and success in Mathematics. The relationship between environment, pedagogy and internal experiences demonstrated here provides a bioecological and holistic view of mathematical learning experiences. Rather than framing enjoyment and self-perception as internal states in isolation, with the responsibility on the pupil to change or improve these states, they are viewed as products of the systems and reciprocal interactions, which is consistent with Bronfenbrenner and Morris's (2006) Process-Person-Context-Time (PPCT) model. In doing so, this research emphasises the salience of cultivating supportive educational contexts that nurture positive mathematical identities from the earliest years of schooling.

Critical Review and Impact Statement

Overview

This final chapter outlines a critical reflection of the research process, from a methodological, theoretical and practical perspective. Firstly, the epistemological perspective of the researcher and the theoretical underpinnings are explored. Next, the methodological aspects of the research are presented, in the context of strengths and limitations of the research. Lastly, the study is situated within the wider educational and psychological literature, considering implications for practice, policy and future research. An impact statement follows, which highlights the potential impact of the research on practice within educational psychological fields.

Research Paradigm

A research paradigm has been described as a means by which the researcher situates the research within their own world view (Guba & Lincoln, 1994; Mackenzie & Knipe, 2006), inclusive of the shared beliefs, perspective and the lens with which the researcher perceives and interprets the research data (Kivunja & Kuyini, 2017). Research paradigms define how research should be conducted and how the findings should be interpreted, taking into account the philosophical orientation of the researcher, which impacts decisions which are made throughout the research process (Kivunja & Kuyini, 2017). From the perspective of Lincoln and Guba (1985), four elements are comprised within research paradigms; epistemology, ontology, methodology and axiology, which underpin the basic assumptions of a research paradigm (Kiyunja & Kuyini, 2017). From an epistemological perspective, in this study, knowledge emerges as a result of interactions between the researcher and participants, aligning with principles of pragmatism. Considering ontology, the current study acknowledges that individual experiences shape reality, and therefore multiple realities are relevant when exploring pupil and teacher perspectives. The flexible and practical nature of the research aligns with a pragmatic ontological stance. The chosen methodology for this study was underpinned by research questions and the goal of obtaining practical insights. The use of a mixed-methods design is supported by the pragmatic paradigm, which supports the use of methods best suited to answer the research questions and generate finding which can be applied to real-world contexts. The positionality of the researcher as a former primary school teacher and trainee educational and child psychologist was consistent with the pragmatic paradigm and axiological assumptions of the research. Meaningful insights were constructed using a reflexive approach, acknowledging both how prior experiences and professional identity informed the methodology and analysis, and how the researcher's values and experiences contributed to generating these insights.

Pragmatism underpinned the research process and methodology in the current study, which provided the researcher with an opportunity to employ flexible methodologies to address the research questions, in the real-world context. Glasgow & Riley (2013) suggest that there are several principles which are important in considering the pragmatist paradigm in research. They have divided the proposed criteria into required criteria and recommended criteria. The research was required to meet key criteria, including relevance to stakeholders, minimal burden, the potential to inform action, and the ability to detect meaningful change (Glasgow & Riley, 2013). Recommended criteria include the research is accessible to most people, maintains norms which align with public health goals, is relatively low-risk, maintains strong psychometric properties and is grounded in theory or a model (Glasgow & Riley, 2013).

These set of proposed criteria have underpinned the research project. Firstly, this research is important to stakeholders, as it provides the opportunity to evaluate maths enjoyment, mathematical self-perceptions, in the context of the recently revised Primary Mathematics curriculum. The qualitative element of the research project places a focus on the pupil and teacher's voices, which highlights the involvement of stakeholders (pupils and teachers) in the research process. Secondly, the research is relatively low burden for both respondents and researchers, as data collection took place on one day in each school. The respondents were not expected to engage with the researcher before or after data collection. From the researcher's perspective, only two days of data collection were required to complete both quantitative and qualitative data collection. Thirdly, the Mosaic approach (Clarke & Moss, 2013) was used to gain pupil perspectives and a qualitive online survey for teachers allowed an insight into the lived experience of pupils, exploring mathematical self-perceptions and enjoyment. The outcomes of this research have the potential to provide a unique insight into experiences in lower primary classes in the Irish context. Finally, Glasgow & Riley (2013) suggest that the research should be reliable over time. The consistency of responses across two different school sites suggests that findings are not context-specific, increasing their reliability over time and setting. Additionally, the lack of significant differences over time, between first- and second- classes, may demonstrate stability in pupil experiences, which suggests that mathematical self-perceptions and enjoyment are robust across early developmental stages.

In summary, the pragmatic paradigm provided a strong and flexible foundation for the current research, which allowed an exploration of mathematical self-perceptions and enjoyment within a real-world educational context, through the integration of multiple methods and perspectives. Aligning the research with the criteria proposed by Glasgow and Riley (2013), stakeholder relevance, minimised participant burden and methodological rigour were prioritised. The incorporation of multiple perspectives, through obtaining both pupil and teacher voices, enriched the findings, while findings observed across different settings and cohorts indicates consistency over time and context. Overall, adopting a pragmatic approach allowed the researcher to engage in a meaningful investigation, grounded in the classroom context which could inform future practice and research within the field of educational psychology.

Theoretical Underpinnings

Two theoretical frameworks underpinned the current research, Bronfenbrenner and Morris' Bioecological Model of Human Development (2006), which includes the Person-Process-Context-Time (PPCT) framework, and the PERMA model (Seligman, 2011). These theoretical frameworks guided the research process by providing complementary lenses to view and understand the experiences of pupils in Mathematics, particularly their enjoyment and self-perceptions. Approaching the research from this perspective, allowed for an holistic exploration of pupils' mathematical experiences. The PPCT model (Bronfenbrenner & Morris, 2006) emphasised the dynamic interplay between the pupil (Person), their interactions when engaging in Mathematics learning (Process), the classroom and school climate (Context) and taking into consideration the developmental timeframe (Time). This provided the researcher with the opportunity to explore how mathematical self-perceptions and enjoyment develop across time and settings, incorporating a holistic and systemic perspective. The PERMA model is grounded in Positive Psychology and framed the current research within a strengths-based context. This enabled the researcher to explore factors which contribute positively to pupils' self-perceptions and enjoyment of Mathematics, focusing on wellbeing and resilience. Collectively, these frameworks informed decisions made relating to research questions, methodology, and interpretation of findings, which encouraged an integrated exploration of the constructs, considering both internal experiences and external influences.

Findings from the current study were interpreted and presented in the context of the two theoretical frameworks. The PPCT model provided a bioecological lens to understand pupil experiences in the context of their environment. Proximal processes (Process) were highlighted as essential to the enjoyment and promotion of positive self-perceptions in Mathematics. Quality of teaching strategies and practices, access to resources and classroom interactions, both between pupils and teachers were reported as impacting pupils' experiences of Mathematics. Pupils emphasised the enjoyment from engaging in whole-class activities and station teaching, which indicated the importance of both the practices involved and the reciprocal interactions in the classroom. Both teachers and pupils identified pupil-teacher interactions as important, with heightened pupil enjoyment when they engaged in a small group with their teacher. Pupils also highlighted the importance of the teacher in encouraging them to maintain a growth mindset, recounting examples of when their teacher praised their efforts over academic accuracy. These proximal processes occur within the context of the school environment, and more specifically, the classroom context (Context). The 'Person' element acknowledges that pupils may have different experiences due to individual differences such as prior experience and temperament which impact the role of environmental factors and systems on mathematical enjoyment and self-perceptions. Finally, the 'Time' component of PPCT is reflected in how experiences of first- and second- class pupils remain stable over time, which suggests positive attitudes and perceptions are developed in pupils' formative years.

Considering the internal emotional and psychological elements which contribute to pupils' Mathematics enjoyment and self-perceptions, the PERMA model provides a framework which complements the ecological perspective. 'Positive Emotions' such as confidence and enjoyment were evident in pupil responses, and this was echoed by teacher responses. Reciprocal interactions discussed as part of proximal processes also contribute to the 'Engagement' element of PERMA, as engagement with learning in Mathematics is linked to pupil participation. These findings are consistent with the NCCA's (2023) systematic review of wellbeing, which identifies relationships, safety and engagement as key factors in children's overall development and educational outcomes (Nohilly et al., 2023). Relationships which cultivated a sense of safety with teachers and peers were identified as essential factors in building resilience and encouraging positive self-perceptions relating to Mathematics. 'Meaning' and 'Accomplishment' are aligned with pupils' sense of mastery, which has the potential to boost motivation and positive self-perceptions among pupils.

Collectively, the PPCT and PERMA frameworks provide a holistic lens through which pupil mathematical experiences can be understood. PPCT emphasises the influence of contextual and relational factors over time, while PERMA highlights the internal mechanisms that arise from these interactions. The integration of these two frameworks facilitates an understanding of mathematical enjoyment and self-perceptions as contextually shape constructs which are fostered through positive emotional experiences.

Personal Reflection on the Research Process

Gibbs' Reflective Cycle has been utilised to structure the personal reflection on the research process. The model facilitates a structured way to reflect on experiences, promoting a systematic process for exploring what was learned, how the researcher responded to it and how these learnings can be applied to future experiences. The six stages are outlined below.

Description

Throughout the research process, the project went through a series of changes. At first, the project was intervention-based and exploring Mathematics anxiety alongside other constructs such as motivation, engagement and self-efficacy. As the project progressed, it became apparent that intervening with this age group would be inappropriate as the literature had not yet explored Mathematics anxiety, and there was no evidence that there was cause for an intervention. As such, the project was amended to explore Mathematics anxiety with children in first- and second- classes. The project changed again to include parents, and finally a strengths-based approach was taken to explore experiences of pupils relating to Mathematics, to include self-perceptions and enjoyment. It was hoped that the research could provide an insight into best practice within Irish classrooms, to help bolster mathematical success and confidence within primary school children. The research process was challenging due to the changes in project; however, it paved the way for a more suitable exploration of Mathematics in the primary school context. Working with schools and children to explore this topic was insightful and forced me to challenge my own biases relating to how Mathematics is taught and has previously been taught within the primary school. Data collection was enjoyable as it was very practical, due to the methods chosen to generate data with the children. Teacher online questionnaires provided welcome insights into their current practice and observations of the children. Facilitating the data collection in this manner allowed teachers a safe space to describe experiences with honesty, reducing the likelihood of social desirability bias. The evolution of the project highlighted the importance of flexibility in research and emphasised the value of aligning research aims with developmental appropriateness and contextual relevance. The use of both qualitative and quantitative methods reflected the pragmatic nature of the study and allowed for a nuanced understanding of pupils' experiences.

Feelings

As the project was going through its various transitions, it was uncomfortable as a researcher, because at times, it felt like the project had no direction and I was regularly reevaluating what I was trying to achieve and accomplish with the project. When the project entered its final transition to the strengths-based approach, I felt more hopeful, and all the research decisions felt easier along the way, as I had clear aims and expectations for the research, alongside a detailed plan of how to carry out the research. As various challenges arose throughout the research process, I tried to approach these in returning to the literature and identifying how other researchers had approached similar challenges. For large portions of the research process, it felt like very little progress was made, and then towards the data collection and analysis part of the process, it felt like everything was happening all at once, which at times, was very overwhelming. I found breaking the tasks into smaller steps and allocating a realistic amount of work to myself each day helped me to overcome that overwhelm. I was excited to see what findings I obtained, as this is an area of significant interest to me. Once I completed the data analysis and extracted the findings, I was satisfied that a contribution to our understanding of pupils' experiences in Mathematics had been achieved. These feelings underscored the emotional demands of doctoral research, and the shifts between uncertainty and clarity, frustration and fulfilment, ultimately made the process more meaningful.

Excerpt from Reflective Journal: There have been so many changes in terminology, constructs and measures, that I have found it challenging to understand what the research will accomplish. Concerns include the timeline and appropriate class level, whether to include parents or not and how the research will contribute to the body of literature. There is so much research on maths anxiety, finding the gap is challenging. I thought including more constructs would make an original contribution, but on reflection, this has made the study feel more disorganised. Going forward, considering feasibility, I need to prioritise refinement and prioritise coherence to strengthen impact and clarity of the study.

Evaluation

The research has several strengths as described above, and there were several points in the research process that felt like moments of success. As I struggled to recruit schools initially, I was so grateful when I received two interested schools, and working with those schools was a pleasure as they were also enthusiastic about the research I was doing and were happy to participate. As I mentioned above, the data collection process was very enjoyable and extracting the common themes from the data was a good experience as it helped me to envision the purpose of the research. Even when findings did not indicate what I had expected, this was still invaluable learning about pupil experiences. There were also several challenges with data collection, recruitment and interpreting the results and understanding their meaning in the context of my research questions. Whilst both positive and negative elements emerged throughout the research process, I feel the learnings from both aspects were integral as I navigated the research journey. The collaborative engagement with schools, coupled with reflective discussions, helped strengthen the coherence and integrity of the project.

Analysis

Although it felt overwhelming at times due to time constraints, I believe that the project had to go through the various stages of development before arriving at the current project, as it gave me a greater understanding of literature in the area and what research was necessary, thus helping me to refine my gap. This made the research project more meaningful in terms of what is relevant to primary school pupils and teachers. While there were periods of uncertainty and ambivalence throughout the project, I felt that the experience of my supervisors helped me to clarify and redirect where necessary to keep the momentum going with my project. I think the methodology, data collection procedures and analysis techniques all contributed to a systematic approach to the research project, which enabled me to return to these during times of indecision. I feel that this was an appropriate and significant approach to take to address the research questions of the project, considering the cohort of pupils I was conducting research with. I also became aware of how my background as a teacher shaped my expectations and influenced the way I read and interpreted both the literature and my own data. This reflective realisation marked a key point in the development of my researcher identity.

The experience has illuminated key insights about research practice. While methodological rigour was upheld, I underestimated the extent to which young children might respond favourably regardless of their true beliefs, especially on self-report Likert scales. This highlights the need for developmentally appropriate research instruments in future studies.

Equally, I learned about my own unconscious biases, shaped by my teaching background, which influenced literature choices, research design decisions, and data interpretation. This realisation prompted deep reflective practice and strengthened the study's trustworthiness. Most importantly, I gained confidence in my ability to adapt, question, and navigate research complexity.

Conclusion

While the research procedures were appropriate and I had considered social desirability bias, I did not expect it to influence the children to the extent that it did, especially in the quantitative aspect of the project. When weighing up the benefits of mixed-methods research, if I was doing a similar project again, I would either do a qualitative piece or modify the quantitative aspect to reduce the impact of social desirability. As a researcher, I have learned that I have engaged well with the research process, with a determination in the face of challenges to see the project through, and also that I had biases that I was unaware of, which were impacting my decision making at all levels, from reviewing the literature, to forming the research design, carrying out data collection and interpreting the results. This resulted in a lot of reflective practice to understand how my biases were impacting the integrity of the research. It has also taught me that acknowledging and working through discomfort is a necessary part of the learning process and contributes to stronger, more ethically sound research. I now recognise the importance of epistemological flexibility, researcher reflexivity and context-sensitive design when working with young children.

Action Plan

Looking at the strengths and limitations of the research, along with the implications and directions for future research, has helped me to identify what I would replicate because it has gone well and what I would change in the future. I believe the experience of completing this project has helped me to shape my growth as a researcher and as an

Educational and Child Psychologist. The learnings taken from this project will be applicable in my future career and any future research undertaken. If undertaking a similar project again, I would explore more innovative ways of reducing bias in young children's responses, perhaps incorporating more participatory or playful data generation strategies. I would also consult more deeply with practitioners and pupils during the planning phase to ensure that the methods used truly reflect their realities. The value of theoretical grounding, particularly in frameworks like PERMA and PPCT, has influenced how I will approach complex constructs such as motivation, wellbeing and engagement in future work. This project has instilled in me a deeper appreciation for the interplay between rigour and flexibility, and the importance of always positioning children's voices at the heart of educational research and practice.

Strengths and Limitations of the Research

Limitations

Design. While the research design was based on Clarke and Moss (2011), an adapted version of the Mosaic Approach was utilised, with prompts provided to children to guide the formation of their collages and pictures. Children were provided with these prompts as school principals stated a concern regarding their capacity to engage with the content, prior to consenting to the project. Both schools were DEIS schools, and principals voiced concerns that the children may find it challenging to engage with a piece of work that was not structured. For this reason, to protect the experience for the children, the approach was amended to include guidelines such as "Can you draw your favourite Maths lesson?" for the drawing and dividing their collages into "Maths at my Desk, Maths in My Classroom, Maths in My School" and "Maths Outside." In this way, the children still contributed a variety of mediums in the information gathering and were provided with adequate guidance to enhance their understanding of the task and experience of the activity. While this adapted version of the Mosaic Approach preserved the multi-modal manner in which the data was collected as intended by Clarke and Moss (2011), the introduction of prompts may have influenced the children's responses, limiting their spontaneous expression of their experiences. This adaptation, while ethically grounded, may have shaped the narratives put forward by the children relating to their experiences of Mathematics.

Sampling/Recruitment Challenges. As the researcher previously worked in a primary school context, recruitment challenges were not anticipated. However, schools were inundated with requests to complete research, and it was incredibly challenging to find schools that were willing to engage with the project and participate, within the timeframe. As such, the researcher utilised convenience sampling, contacting schools that they had previously taught in, asking them to participate. One of the schools had really excited the children, and they all wished to participate in the Mosaic Approach, which caused disappointment for many of them. The children had been informed that Miss X was coming and that she was a teacher in that school, which increased the social desirability bias, as the children very obviously wanted to impress the researcher, who they perceived to be a member of staff, even though they were not in the school when the researcher taught there. While the use of convenience sampling is practical, it does impact the potential for generalisation of the findings beyond the individual contexts of the schools who participated in the research. Additionally, prior affiliation with one of the schools, may have had an unintentional impact on the children's responses, as a result of reinforced social desirability.

Data Collection and Analysis. Inconsistencies in the data collected were observed. For example, mainstream class teachers provided detailed descriptions of their experiences and were open regarding their observations of their pupils, and the implementation of the Redeveloped Primary Mathematics Curriculum curriculum. SET teachers provided less information, and the quality of the information provided was less rich. It is probable that mainstream class teachers have a greater investment as it directly relates to the children they are responsible for. These inconsistencies in teacher data may reflect differences in the perceived relevance of the curriculum across roles. Future research could devise a separate survey for SET teachers, which may be tailored to their specific role.

During data collection, developmental sensitivity was observed relating to the children's capacity to engage in higher order thinking and provide responses to 'why' questions. They could describe what they enjoyed about Mathematics lessons or what they liked about Mathematics but found it very challenging to describe why they felt that way. This impacted the findings as they struggled to articulate the depth of their experience, especially relating to experiences in previous classes. The developmental limitations of 7-9 year olds as informants in the research, from the perspective of inferencing and identifying cause, may indicate a need for greater scaffolding when considering questions for children this age.

Strengths

Holistic Perspective on Child Development. Findings from this research study contribute to the holistic development of the child, which can be considered more applicable to their lived experience. In the literature relating to Mathematics, a focus is often on cognitive factors only, as achievement is measured by attainment. This research study contributes findings that are categorised as emotional factors and contribute to an in-depth understanding of the interplay between different aspects of development. Additionally, understanding that development in one aspect can impact the long-term growth in another aspect is encapsulated in a holistic perspective (Miller et al., 2018; Stodden et al., 2023). Through addressing wellbeing as a multifaceted construct, a more comprehensive approach can be taken to support children and enhance their emotional development in conjunction with their social and cognitive development (Lewis, 2019). This study has contributed to the holistic perspective on child development, by focusing specifically on affective factors relating to pupil experiences of Mathematics in primary school. Findings indicated that pupils who participated in the study demonstrated predominantly positive attitudes towards Mathematics, emphasising the central role of teachers, the use of concrete materials and a preference for collaborative learning opportunities. Key affective individual characteristics such as resilience, growth mindset, confidence and self-awareness were established, all of which can be included in the five dimensions of the PERMA model of wellbeing (Seligman, 2011), which underpinned this study. Through the integration of these affective components within this framework, this research advances understanding of child development, which embodies emotional wellbeing in addition to cognitive development.

Alignment of Perspectives. A strength of the study is in the alignment between pupils' and teachers' perspectives, as evidenced by the integrated findings from both qualitative and quantitative data. This indicates that the theoretical framework, research design, data collection and analysis converged in response to the research questions. This alignment provides an indication that the findings are coherent and relate to the research questions and objectives. The constructs under exploration, mathematical self-perceptions and enjoyment were effectively explored through this process. As a result, clear insights were provided by participants which directly related to the research questions, enabling an insight into pupil experiences of Mathematics. This improved the validity of the research as findings are aligned with the theoretical concepts being explored.

As part of the research methodology, perspectives from pupils and teachers were considered. Having analysed the data, similar experiences were described by teachers and pupils relating to pupil experiences of Mathematics. Triangulating the data enhanced the validity and reliability of the responses, providing two perspectives on the same topic. The alignment between pupil and teacher accounts of pupil experiences, provide a multifaceted understanding relating to elements that impact attitudes relating to Mathematics, specifically self-perceptions and enjoyment. Both groups emphasised the importance of engaging teaching strategies, the importance of representing tasks in a concrete manner, and the importance of reciprocal interactions in the classroom context. Where pupils identified enjoyment, resilience and confidence, these affective factors were echoed in teacher reports, with an emphasis on these individual characteristics for the cultivation of positive mathematical experiences.

Implications of Research for Understanding and Knowledge of the topic in Psychology

Advancing Psychological Theories

This research study furthers the understanding of psychological theory relating to Mathematics Enjoyment and Self-Perceptions. While the quantitative findings were not significant, understanding that there are no differences within that cohort of pupils' experiences is valuable information, as it allows us to focus on children in older class levels and their attitudes towards Mathematics. These findings contribute to previous research in the area which suggest that negative attitudes towards Mathematics emerge as children advance through primary school. As previous research has indicated that children in upper primary experience negative attitudes towards Mathematics, research in lower primary had not yet been conducted to eliminate this cohort of pupils. This is of importance as it highlights the impact of early intervention in lower primary classrooms and indicates that perhaps a need for a higher level of intervention in upper primary is required. The highlights the need for longitudinal research to support the development of early intervention.

Extending Psychological Frameworks

This research was underpinned by two frameworks, the PERMA framework (Seligman, 2011) and the PPCT framework (Bronfenbrenner & Morris, 2006). These frameworks provide a helpful insight into the categorisation of Mathematics enjoyment and self-Perceptions, in terms of their capacity to impact overall wellbeing. Mathematical self-perceptions and enjoyment directly relate to several elements of the PERMA framework. Enhancing mathematical experience can lead to positive emotions as pupils engage with and enjoy Mathematics. Experiencing feelings of satisfaction or accomplishment relating to Mathematics, and therefore feeling competent in the subject can boost motivation and lead to positive emotions. When pupils experience enjoyment within Mathematics lessons, they are more likely to participate and engage with the activities and tasks, leading to more intentional involvement in lessons. This can result in pupils approaching Mathematics with persistence and critical thinking, which could potentially result in greater mathematical success and feeling accomplished and competent in the subject.

Bronfenbrenner and Morris (2006) Bioecological Model of Human development also underpinned this research, to deepen understanding of pupil's mathematical experiences. Proximal processes are highlighted in this model, and their significance to the development of the child. Specifically relating to this study, these processes refer to the pupils' engagement with learning in Mathematics and the social interactions that are involved in that process, working with their teachers and collaborating with peers. In the context of the introduction and implementation of the Redeveloped Primary Mathematics Curriculum, the PPCT model is of relevance, as it refers to systemic change from a pedagogical perspective. This model can help to conceptualise the change happening around the child, and how that might impact their learning experiences. Understanding how systemic change and reform can impact pupils and their engagement with proximal processes over time can enable teachers and psychologists to foster the development of adaptive learning environments.

Implications for Professional Practice in Educational Psychology and Schools

The current research aimed to explore teacher and pupil perspectives of mathematical enjoyment and self-perceptions within the primary school context. Outcomes from the research can guide professional practices in Educational Psychology, with a focus on improving both emotional and academic outcomes for Irish primary school pupils.

Contribution to field of Educational Psychology

This study provides valuable insight into the early Mathematics experiences, contributing a distinct psychological perspective on the development of children in Irish primary schools, considering both an internal lens on the pupil experience (PERMA) and the educational system within which pupils are operating through Bioecological Model of Human Development, specifically framed using the Process-Person-Context-Time (PPCT) model (Bronfenbrenner & Morris, 2006). The study demonstrates how positive affective states (PERMA) such as enjoyment and self-perceptions can be fostered in Mathematics through proximal processes between pupils and their environment, specifically classroom climate, teacher relationships and individual pupil characteristics. The research highlights the importance of continuity in catering to cognitive and emotional needs of pupils, including curriculum content, pedagogy and emotional capacity to foster motivation and self-concept which collectively are related to the Context component of PPCT (Bronfenbrenner & Morris, 2006). This study also offers a reframing of mathematical self-perception, in illuminating the relational and process-driven aspects, moving away from ability-based perceptions, encouraging strengths-based approaches to bolster pupils' confidence. Both 'Person' and 'Time' elements of PPCT (Bronfenbrenner & Morris, 2006) are represented in this finding. The 'Person' element highlights individual characteristics as being of paramount importance in maintaining positive attitudes towards Mathematics. The 'Time' component underscores the salience of the developmental stage of pupils in junior primary classes, which represents a period of psychological safety, fostering positive beliefs and attitudes towards Mathematics, which if reinforced, may negate the development of negative attitudes in the future. Framing the implementation of the Redeveloped Primary Mathematics Curriculum within the PPCT model (Bronfenbrenner & Morris, 2006) offers a distinct psychological perspective into the factors that impact pupils' affective development, which includes systemic elements. Overall, the research advances understanding of how thriving psychologically can be cultivated in academic contexts. It further supports the narrative that early positive mathematical experiences, can have lasting impacts in terms of sustained motivation, confidence and academic wellbeing.

The Role of Educational Psychologists in Promoting Mathematical Confidence. When educational psychologists are presented with concerns relating to Mathematics, it is often in the context of a learning assessment, with schools asking psychologists to complete a diagnostic piece of work with a pupil. Addressing cognitive and emotional factors impacting engagement and academic success is part of the assessment. This involves integrating psychometric tools, observations and gaining pupil perspectives to better understand their experience of engaging with Mathematics. Educational psychologists can extend their role in the assessment process to consider the broader cognitive, emotional and contextual factors that influence mathematical confidence and engagement. In learning, motivation and engagement are closely linked, looking beyond the cognitive processes (Xia et al., 2022). Barriers to learning such as disengagement, lack of motivation or a lack of attention or concentration are often highlighted. These barriers are frequently perceived in a negative light within the context of pupil engagement. Understanding the function of these behaviours and reframing the behaviours for teachers and parents can help them to understand that while children may appear disengaged, they may be struggling to access lesson material or experiencing mathematical anxiety (Shabab, 2024). To guide support, the PERMA framework (Seligman, 2011) can aid in the understanding and the cultivation of positive mathematical learning experiences for children. Promoting strengths-based approaches through working with schools and teachers, can help to reduce anxiety and increase enjoyment of pupils. Educational psychologists can build capacity within schools by helping teachers to design meaningful lessons that incorporate hands-on approaches, relate learning to real-life experiences and enable children to build positive relationships when collaborating with peers and teachers. Through encouraging a growth mindset approach to learning, educational psychologists can promote feelings of competence and success within pupils.

Conducting research with young children can pose challenges from a developmental perspective, considering their capacity to respond accurately, specifically relating to measures. As an educational psychologist, this emphasises the need to carefully select and adapt assessment tools for younger children. It is also important to consider the context within which the data is gathered and who is gathering the data. When gaining pupil perspectives, the “My thoughts about school” checklist is often used. It is of significance to consider who is best placed to ensure the child feels at ease, creating a safe environment which allows the child to authentically respond to the questions. Depending on the relationships within the school, the perception of the school relating to the child and the consideration of the system within which the child is functioning, it may be more appropriate for a teacher/SNA to complete this with the child. If the psychologist is deemed the more appropriate person, rapport building and trust are of paramount importance, considering the potential impact on data quality.

Psychologists can provide support through evidence-based intervention, which encourage a reframing of thoughts, fostering resilience and perseverance in maths-related tasks. Promoting a growth-mindset, catching negative thoughts and reframing them can be helpful tools which are relatively simple for teachers and parents to implement (Samuel & Warner, 2019). Educational psychologists may also have a role to play in the professional development of teachers, cultivating a greater understanding of needs of children and equipping them with strategies to help children who are struggling with Mathematics from a cognitive or emotional perspective. Taking all the above into consideration, educational psychologists have a central role to play in assisting those in the child's life to understand and nurture their needs, meet the child at the level they currently are at, helping them to construct a positive relationship with Mathematics, which will promote the development of lifelong skills in problem-solving. Aligning educational psychology practice with the PPCT model, it is of importance for educational psychologists to consider the multiple ecological systems and processes which impact child development. Working within microsystems in the classroom to support pupil learning, whilst also having an understanding of macro-level changes within the system such as curricular reform provides the educational psychologist with a unique role of facilitating systemic change whilst embedding psychological insights into the implementation of these changes through school policy and classroom practice.

Supporting Teachers in Creating Engaging Mathematical Environments. The Redeveloped Mathematics Curriculum was introduced to encourage engagement of pupils underpinned by a child-centred approach to learning with an emphasis on creativity, collaboration, challenge and playfulness. This curriculum is based on pupil-centred principles, prioritising the needs of pupils over traditional teacher-led instruction (Qafa et al., 2024). The curriculum promotes greater flexibility for teachers to determine the content and pacing of their lessons, with a focus on learning outcomes of pupils. The curriculum was intended to be interpreted as a dynamic approach to the teaching of Mathematics, with an adjustment in practice from prescriptive curricula and tasks to creating a more responsive learning environment. Teaching professionals have finetuned their teaching strategies and practices to align with the 1999 curriculum, and it can be challenging to engage in an overhaul of these practices. The Redeveloped Mathematics Curriculum may be met with some resistance from teachers who feel that the changes are unnecessary, and that the 1999 curriculum aids pupil progression sufficiently. Teacher attitudes towards the implementation of new curricula have a significant impact on the success of its implementation (Thura & Khaing, 2020). There may be a role for the Educational Psychologist in facilitating a change in attitude towards the implementation of the curriculum particularly if teachers perceive it as an additional burden to an ever-growing workload. Emphasising inclusive practices to support diverse learners in Mathematics and making Mathematics accessible to all learners could facilitate a change in attitude where necessary. Additionally, defining the role of the teacher within pupil-centred approaches (Trinidad, 2020) could be beneficial in assisting the teachers to reframe their perception of their role within the teaching and learning process. Should teachers continue to struggle with the implementation of child-led pedagogies, there may be scope for the educational psychologist to recommend additional support beyond initial professional development. This acknowledges that pedagogical change is a process, with sustained progress over time underpinned by relevant guidance and scaffolding.

To conclude, Educational Psychologists can play a pivotal role in assisting teaching professionals to foster engaging and supportive mathematical learning environments in primary classrooms. By focusing on building teachers' capacities to create dynamic, inclusive classrooms, Educational Psychologists can help bridge gaps in student engagement and mathematical confidence. Additionally, through information gathered during assessment, Educational Psychologists can evaluate cognitive and emotional factors and suggest helpful strategies for combating these factors, promoting positive mathematical experiences for all pupils. As schools continue to evolve and develop, adapting to the implementation of the Redeveloped Mathematics Curriculum, integrating psychological insights with professional practice will be essential in allowing all pupils to access the curriculum at their own level whilst experiencing mathematical success and achievement.

Implications for Future Research

Guiding Future Investigations

In extending the findings of the current study, future research should consider exploring the long-term effects of the implementation of the Redeveloped Primary Mathematics Curriculum, investigating the experiences of children as they progress through primary school and transition to secondary school. While this study found consistent experiences among pupils of first- and second- classes, and no differences across genders, it is beyond the scope of this study to monitor whether positive attitudes are maintained over time. Tracking mathematical self-perceptions and enjoyment of pupils over time will help to pinpoint if negative attitudes emerge later in primary school. This is of particular importance given findings from previous studies, which indicate that gendered beliefs emerge in upper primary in addition to negative attitudes towards Mathematics, and a reduction in enjoyment as a result. Framing future studies within the context of the PPCT model (Bronfenbrenner & Morris, 2006), an examination of how proximal processes within the classroom climate in addition to contextual elements impact the positive attitudes and experiences over time ('Process' and 'Time' components). Additionally, through tracking children's experiences over times, an insight can be gained into how early experiences shape later experiences and impacts on pupil wellbeing balanced with academic outcomes can be identified.

Future research should also investigate intersectionality, especially in the case of gender, socioeconomic status and cultural background. This could potentially provide an insight into how these factors intersect and influence the development of pupil beliefs relating to Mathematics. While no gender differences emerged in the current study, it is possible that other narratives evident in society may contribute to pupils' experiences as the progress through the educational system. It is of particular significance to be mindful of the gender imbalance in the current sample, which resulted in a disproportionate number of female participants (72%). While not the focus of the study, this demographic detail has implications for the interpretation of findings, especially regarding gender-based analyses. Although the study contributes valuable insights into early mathematical experiences, the results may not fully capture the perspectives of boys. Future research should aim for a more gender-balanced distribution to strengthen the applicability of findings across diverse school contexts. Incorporating the PERMA framework into future studies could enable researchers to explore how differences in ‘Positive Emotion’, ‘Engagement’ or ‘Accomplishment’ have the potential to evolve and contribute to the identification of areas for targeted support.

Future research could also consider exploring the efficacy of interventions aimed at improving mathematical self-perceptions and enjoyment. The findings of the current study, which emphasised pupil confidence, resilience, and teacher-supported learning as significant elements which impact mathematical experiences of pupils could provide a foundation for future studies to approach intervention from a strengths-based perspective also. Future interventions could incorporate elements of the Redeveloped Primary Mathematics Curriculum such as play-based pedagogy and collaborative learning, with a focus on affective outcomes.

Recommendations for Methodological Approaches

Future research should also implement mixed methods approaches to gain an insight and fuller understanding of pupil experiences and how they engage with Mathematics and perceive their own mathematical ability. Quantitative data allows for the identification of patterns and trends in attitudes of pupils, specifically mathematical self-perceptions and enjoyment, with qualitative data enhancing these findings and including the pupil voice which further develops the understanding of pupils’ lived experience. Adopting this methodological approach aligns with the PPCT model (Bronfenbrenner & Morris, 2006), which highlights the importance of gaining an understanding of person-specific components and their interaction with contextual factors over time.

Future research could also consider the utilisation of a quasi-experimental design or longitudinal design to determine causal relationships between teaching practices and changes in affective outcomes and evaluate any interventions that were implemented. This could inform evidence-based practice, which would be relevant to educational psychologists and schools who were seeking to implement such practices within school systems. Both pupils and teachers in this study identified classroom practices as having a strong impact on the development of positive mathematical attitudes in pupils. Evaluating future intervention research using the PERMA framework, and specifically, the impact on components such as Engagement and Accomplishment would allow for a strengths-based approach to the evaluation of interventions also.

Finally, technology was an aspect of findings from this research which was prominent throughout data collection with respect to both pupils and teachers. Pupils expressed enjoyment relating to the use of digital learning platforms. Future research could consider exploring the impact of digital learning tools on pupils' mathematical self-perceptions, specifically relating to the role of self-paced learning and gamification, and the impact on motivation and confidence of pupils over time. Intersectionality and equity could also be explored in the context of access to resources, identifying if technology is accessible to all learners, or if disparities exist and therefore impact the mathematical experiences of pupils. Beyond access to resources, the quality of pedagogical use is of significance, and the meaningful integration of technology into learning experiences for children. Effective implementation requires active, inclusive learning experiences, ensuring that the use of technology enhances and enriches the lesson, contributing to the progression of the pupils and helping them to achieve lesson outcomes.

Distinct Contribution to the Knowledge of the Subject/ Evidence of Originality

Novel Insights

The current study offers novel insights and perspectives on the experiences of pupils, specifically regarding their mathematical self-perceptions and enjoyment, in the context of the Redeveloped Primary Mathematics Curriculum. Through an exploration of mathematical enjoyment through the lens of PERMA framework (Seligman, 2011) and PPCT model (Bronfenbrenner & Morris, 2006), the current study provides novel understanding of the emotional experiences that impact Mathematics learning. Of note, findings from the study indicate that pupils generally maintain positive attitudes towards Mathematics, with no significant differences in enjoyment or self-perceptions between first- and second- class pupils or across genders. This indicates that junior primary pupils, regardless of class level or gender, experience similar levels of enjoyment and self-perceptions in Mathematics at this stage in the Irish context. This aligns with the PPCT model (Bronfenbrenner & Morris, 2006), which underscores the pivotal role of reciprocal interactions (Process), the individual attributes of the child (Person), the immediate environment (Context) and how this develops over time (Time). The study emphasises the potential for classroom practices, considered proximal processes, cultivate resilience and a growth mindset, which are essential in boosting positive engagement with the subject (PERMA's 'Engagement' and 'Accomplishment'). Furthermore, these findings emphasise the propensity for flexible, play-based approaches to enhance pupil confidence, and cultivate resilience and a growth mindset in pupils. The study identifies the role of a supportive classroom climate and teacher practices in maintaining positive emotional experiences in Mathematics learning. The potential for pedagogy and classroom practice to bolster pupil confidence and foster resilience and a growth mindset, through a flexibility to approaching Mathematics learning has been identified in this study. Findings from the current study highlight the salience of microsystems in nurturing pupils' emotional and cognitive development.

Filling Gaps in Existing Literature

Existing studies have largely focused on Mathematics anxiety (MA) and interventions to mitigate negative feelings towards Mathematics. Contrastingly, this study takes a strengths-based approach to explore feelings related to Mathematics, focusing on positive constructs such as enjoyment and self-perceptions. Underpinned by PERMA, 'Positive Emotion' and 'Engagement' are identified as critical components of mathematical learning. Additionally, the study applied the PPCT model to examine the impact of interactions over time in the classroom context, and how they contribute to the child's development. As the Redeveloped Primary Mathematics Curriculum is in its infancy, with schools having implemented it for just over a year, it is unlikely that research relating to mathematical experiences has been completed in the context of its implementation. Additionally, much of the existing research has targeted older children in primary school, which has left a gap in understanding the experiences of younger pupils. This study contributed to findings that bridge the gap between preschool and upper primary. The quantitative findings, which found no significant differences in enjoyment or self-perceptions between class groups or genders, provide a unique contribution in suggesting that lower primary class levels are part of a pivotal stage in child development, with an opportunity to foster positive mathematical attitudes before typical gender or class level differences emerge.

Methodological Insights

This study has utilised a mixed methods approach to explore mathematical enjoyment and self-perceptions, which provides a rich insight into the experiences of pupils, using triangulated quantitative and qualitative data which is considered more valid and reliable, contributing to the integrity and rigour of the research. Quantitative analyses revealed consistency in levels of enjoyment and self-perceptions of pupils across first- and second- classes, and between boys and girls. This reinforces the suggestion of stability in affective development at this stage of primary school. Qualitative findings enriched the quantitative understanding by capturing pupils' voices relating to their positive mathematical experiences, including the importance of teacher support, concrete materials, and group learning materials. These correspond to the 'Context' and 'Process' components of the PPCT model (Bronfenbrenner & Morris, 2006) and the 'Relationships' and 'Engagement' elements of the PERMA framework (Seligman, 2011). This triangulation contributes to the rigour of the study, as findings both confirm quantitative findings and provide rich insights into the context and practices which foster the development of positive attitudes towards Mathematics. Given the integration of the theoretical frameworks to the methodological approach to the research questions, an application of theory to empirical data is observed. This paves the way for practical application of findings for both teachers and educational psychologists to continue to enable the holistic development of the child in Mathematics learning.

Impact Statement

The current research aimed to explore the perspectives of pupils and teachers of mathematical enjoyment and mathematical self-perceptions in the context of the implementation of the Redeveloped Mathematics Curriculum, which was introduced in primary schools and special schools in 2023. When considering the potential impact of the research, it is essential to consider the stakeholders involved and how the current research could generate change within the field of educational and child psychology. The findings from this research are relevant to members of the school community in Ireland, inclusive of pupils, teachers and parents. Alongside this, the findings are relevant to those working in curriculum development and professional training for teachers, such as the NCCA and Oide. On a national level, the findings should be considered in future policy and strategies implemented by governments in the approach to improving outcomes for Irish pupils in the areas of Mathematics and STEM. When evaluating the contribution of the current research to the academic community, it is of importance to emphasise how the limitations of this research could improve the quality of future research, particularly with reference to the methodology and conducting research with younger age groups of children. One important consideration for the impact and applicability of this research is the gender distribution of the sample. With 72% of participants identifying as female, due to one school being single-sex, the findings may not fully capture the perspectives of boys. While international research highlights a mathematics confidence gap between genders, this pattern did not clearly emerge in this study. This may indicate early benefits of the Redeveloped Mathematics curriculum's inclusive and strengths-based ethos. Nonetheless, a more balanced sample would strengthen future work, particularly where the aim is to inform policy or practice relating to gender equity in mathematics education.

Additionally, this research contributes to the overall knowledge of experiences of pupils and teachers relating to Mathematics in the Irish Primary DEIS School context, with a greater understanding of what aspects of lessons promote mathematical enjoyment and bolster positive mathematical self-perceptions. This knowledge can inform future practice within the teaching profession, as children highlighted the elements which enhance their learning and overall experience in Mathematics. The PPCT model provides a valuable lens through which to consider the influence of the DEIS setting in this research. The 'Context' element of the model highlights the significance of school and community environments in shaping children's development. DEIS schools are designed to support children at risk of educational disadvantage through processes that include strong teacher-pupil relationships, targeted pedagogical approaches, and home-school partnership initiatives. These elements likely enhanced the proximal processes experienced by the children in this study, supporting more positive mathematical self-perceptions and enjoyment. Furthermore, the emphasis on equity and engagement within DEIS policy aligns with the PERMA and Positive Psychology approach taken in this research. Future research could consider exploring how home-school partnerships in DEIS contexts specifically contribute to children's mathematical self-perceptions and enjoyment, potentially offering a deeper understanding of how ecological supports influence learning experiences.

This research provides a basis for future research with this age group of children, who are an underrepresented cohort, as previous research has mainly been completed with older children. This research highlights the challenges of conducting research with younger children and limitations of the research can be used to enhance future studies with this cohort of children. The Mosaic Approach has been considered an appropriate method for eliciting responses from young children. Whilst conducting this research, social desirability was identified as a barrier to obtaining accurate information regarding the children's experiences of Mathematics, and even with using the child-friendly method of data collection, children were reluctant to make any comments that may be perceived as negative. This gives us an insight into how children have experienced their true feelings being received by adults in the past and perhaps indicates that more open spaces for discussion are required in educational settings, where all opinions and feelings are respected and discussed objectively. The advent of the Redeveloped Curriculum has encouraged educational professionals to change their approach to the teaching of Mathematics, and teacher perspectives obtained during this research indicate that the Redeveloped Curriculum has provided the space for teachers to think about Mathematics teaching in a different way. Teachers indicated a shift from instructional teaching and learning, to focusing on the process of Mathematics, encouraging children to find different ways of approaching Mathematics problems and enabling pupils to discuss their methods. To conclude, the current research is relevant to several individuals who are involved in and affected by education. These include members of the school community, policy makers, curriculum developers and researchers in education. From an Educational and Child Psychology perspective, in working with a variety of groups, it is of importance that psychologists would have an awareness of the potential impact of the Redeveloped Curriculum and the importance of its effective implementation for the improved Mathematics experience for pupils in Irish primary schools.

In conclusion, this research has provided valuable insights into how Irish primary school pupils experience Mathematics in the context of the Redeveloped Primary Mathematics Curriculum, highlighting the roles of mathematical enjoyment and self-perceptions in shaping early learning experiences. The use of a strengths-based, mixed-methods approach, centred on pupil voice and teacher perspectives, enabled a nuanced exploration of how positive emotions, engagement, and perceptions of competence can support children's mathematical development. While challenges such as response bias and methodological limitations were encountered, they offered important learning opportunities and informed recommendations for future research and practice. This study contributes meaningfully to the evolving discourse around Mathematics education in Ireland, underscoring the importance of pedagogies that nurture curiosity, confidence and a sense of capability in young learners. By positioning enjoyment and self-belief as central to mathematical development, this work advocates for classroom practices that not only support achievement but also promote long-term mathematical wellbeing. Future research may benefit from exploring these constructs across a broader range of class levels and school contexts, as well as considering longitudinal approaches to track how mathematical self-perceptions and enjoyment evolve over time. Additionally, further investigation into how teacher practices and curriculum implementation influence pupil experiences would deepen understanding and help shape effective, inclusive, and engaging Mathematics education.

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Appendices

Appendix A: Research Timeline

Appendix B: List of Articles with Reason for Exclusion

	Name of Article	Reason for Exclusion
1.	Effort, Enjoyment, and Self-Confidence: A Mediation Model (Chue, 2020).	Exclusion Criteria 1. This research is undertaken with tertiary level students only.
2.	Learning environment and students' mathematics attitude (Vandecandelaere et al., 2012).	Exclusion Criteria 1. This research is undertaken with young people in Grade 8 (13 year olds) in Belgium.
3.	How affective-motivational variables and approaches to learning predict mathematics achievement in upper elementary levels (García et al., 2016).	Exclusion Criteria 1. This research is undertaken with young people in upper primary (fifth and sixth grade).
4.	Predicting school achievement from general cognitive ability, self-perceived ability, and intrinsic value (Spinath et al., 2006).	Exclusion Criteria 2. This research is focused on investigating motivation as a predictor of school achievement.
5.	Enjoyment of learning and its personal antecedents: Testing the change-change assumption of the control-value theory of achievement emotions (Buff, 2013).	Exclusion Criteria 1. This research is undertaken with young people in upper primary (mean age 12.01 years).
6.	Perceived classroom support: Longitudinal effects on students' achievement emotions (Forsblom et al., 2020).	Exclusion Criteria 1. This research is undertaken with 10-15 year olds.
7.	Teacher support and math engagement: roles of academic self-efficacy and positive emotions (Liu et al., 2017).	Exclusion Criteria 4. This research is undertaken in China which is not an OECD member state.

8.	Measuring the Mathematical Attitudes of Elementary Students: The Effects of a 4-Point or 5-Point Likert-Type Scale (Adelson & McCoach, 2010).	Exclusion Criteria 3. This is a validity study.
9.	The paradoxical relationship between student achievement and self-perception: a cross-national analysis based on three waves of TIMSS data (Shen & Tam, 2008).	Exclusion Criteria 4. This research includes data of several countries which are not OECD member states.
10.	Investigating Students' Attitudes towards Learning Mathematics (Mazana et al., 2018).	Exclusion Criteria 1. This study is undertaken with children in primary school, in addition to young people in secondary school.
11.	Evaluating the Results of PISA Assessment: Are There Gaps Between the Teaching of Mathematical Literacy at Schools and in PISA Assessment? (Kusmaryono, 2023).	Exclusion Criteria 4. This study is undertaken in Indonesia, which is not an OECD member state.
12.	Self-Concept and Achievement in Math Among Australian Primary Students: Gender and Culture Issues (Han, 2019).	Exclusion Criteria 1. This study is undertaken with upper primary school pupils (ages 10-13).
13.	Identifying affective domains that correlate and predict mathematics performance in high performing students in Singapore (Lim & Chapman, 2013).	Exclusion Criteria 1. This study is undertaken with students in a pre-tertiary education programme (aged 17).
14.	Numerical Literacy and Math Self-Concept of Children with Special Needs in Inclusive Elementary Schools (Waluya & Sukestiyarno, 2023).	Exclusion Criteria 4. This study is undertaken in Indonesia, which is not an OECD member state.
15.	Perception of Mathematics Self-Efficacy and Achievement of Primary School Students (Basak & Ghosh, 2014).	Exclusion Criteria 4. This study is undertaken in India, which is not an OECD member state.

16. Towards an Integrative Model of Math Cognition: Interactions Between Working Memory and Emotions in Explaining Children's Math Performance (Van der Ven et al., 2023).	Exclusion Criteria 2. This study focuses on exploring Mathematics enjoyment relating to motivation and cognition.
17. Control-Value Appraisals, Enjoyment, and Boredom in Mathematics: A Longitudinal Latent Interaction Analysis (Putwain et al., 2018).	Exclusion Criteria 1. This study was undertaken with children in upper primary school (in their final year of primary schooling).
18. Influence of Game Quests on Pupils' Enjoyment and Goal-pursuing in Math Learning (Chen et al., 2011).	Exclusion Criteria 4. This study was undertaken in Taiwan, China, which is not an OECD member state.
19. Mathematics: I don't like it! I like it! Very much, a little, not at all... Social support and emotions in students from 2nd and 3rd cycles of education (Monteiro et al., 2017).	Exclusion Criteria 1. This study was undertaken with children in upper primary school (mean age 12.6 years)
20. Emotions, Self-Regulated Learning, and Achievement in Mathematics: A Growth Curve Analysis (Ahmed et al., 2012).	Exclusion Criteria 1. This study was undertaken with children in upper primary school (mean age 12.8 years)
21. Math Circles Inscribed in Ohio (Locke et al., 2012).	Exclusion Criteria 1. This study was undertaken with young people in high school.
22. Development and Psychometric Properties of the Math and Me Survey: Measuring Third Through Sixth Graders' Attitudes Toward Mathematics (Adelson & McCoach, 2011).	Exclusion Criteria 3. This is a validity study.
23. Self-Concept And Self-Efficacy In Mathematics: Relation With Mathematics Motivation And Achievement (Skaalvik & Skaalvik, 2009).	Exclusion Criteria 1. This study was undertaken with children in middle school and young people in high school.

24. Skill-Builders: Improving Middle School Students' Self-Beliefs for Learning Mathematics (Falco et al., 2008).	Exclusion Criteria 1. This study was undertaken with children in upper primary school only.
25. Interplay Among School Climate, Gender, Attitude Toward Mathematics, And Mathematics Performance Of Middle School Students (Choi & Chang, 2011).	Exclusion Criteria 1. This study was undertaken with middle school students (ages 11-13).
26. Students' perceptions of the learning environment and attitudes in game-based mathematics classrooms (Afari et al., 2012) .	Exclusion Criteria 1. This study was undertaken with college students.
27. Child, Mother, Father, and Teacher Beliefs About Child Academic Competence: Predicting Math and Reading Performance in European American Adolescents (Putnick et al., 2019).	Exclusion Criteria 1. This study was undertaken with adolescents.
28. Mehrdimensionale Bildungsziele im Mathematikunterricht und ihr Zusammenhang mit den Basisdimensionen der Unterrichtsqualität (Schiepe-Tiska et al., 2016).	Exclusion Criteria 6. This study is not published in English.
29. Self-concept mediates the relation between achievement and emotions in mathematics (Van der Beek et al., 2017).	Exclusion Criteria 1. This study is undertaken with secondary school pupils.
30. Awareness of a gender stereotype, personal beliefs and self-perceptions regarding math ability: when boys do not surpass girls (Martinot & Désert, 2007).	Exclusion Criteria 1. This study is undertaken with children in upper primary school.
31. Stavovi učenika osnovne škole prema matematici (Vidić, 2015).	Exclusion Criteria 6. This study is not published in English.
32. Finnish primary and secondary school students' interest in music and mathematics relating to enjoyment of the subject and perception of the importance and usefulness of the subject (Tossavainen & Juvonen, 2015).	Exclusion Criteria 1. This study is undertaken with secondary school pupils.
33. Student reflections on learning with challenging tasks: 'I think the worksheets were just for practice, and the	Exclusion Criteria 2.

	challenges were for Mathematics' (Russo & Hopkins, 2017).	This study is focused on exploring Mathematics cognition.
34.	Factors impacting on students' beliefs and attitudes toward learning mathematics: Some findings from the Solomon Islands (Kele, 2018).	Exclusion Criteria 4. This study is undertaken in the Solomon Islands, which is not an OECD member state.
35.	An Investigation of Measurement Invariance by Gender for the Turkish Students' Affective Characteristics Who Took the PISA 2012 Math Test (Gülleroğlu, 2017).	Exclusion Criteria 1. This study is undertaken with adolescents.
36.	Investigating the effects of Computer-Assisted Instruction on Achievement and Attitudes towards Mathematics Among Seventh-Grade Students in Kuwait (Soliman & Hilal, 2016).	Exclusion Criteria 4. This study is undertaken in Kuwait, which is not an OECD member state.
37.	A control-value approach to gender differences in emotions towards mathematics (Frenzel et al., 2007).	Exclusion Criteria 1. This study is undertaken with children in upper primary school only.
38.	Elements of mathematical predictive performance in compulsory secondary education students (Muñoz Cantero et al., 2018).	Exclusion Criteria 6. This study is not published in English.
39.	Math Anxiety And The "Math Gap": How Attitudes Toward Mathematics Disadvantages Students As Early As Preschool (Geist, 2015).	Exclusion Criteria 1. This study is undertaken with adults only.
40.	How to Feel About and Learn Mathematics: Therapeutic Intervention and Attentiveness (Namukasa et al., 2009).	Exclusion Criteria 1. This study is undertaken with adults only.
41.	The Implementation of Learning Together in Improving Students' Mathematical Performance (Hobri et al., 2018).	Exclusion Criteria 4. This study is undertaken in Bangladesh, which is not an OECD member state.
42.	Cognitive Appraisals, Achievement Emotions, and Students' Math Achievement: A Longitudinal Analysis (Forsblom et al., 2021).	Exclusion Criteria 1. This study is undertaken with young people aged 10-15 years old.

43. Students' Affective Characteristics and Their Relation to Mathematical Literacy Measures in the Programme for International Student Assessment (PISA) 2003 (Güzel & Berberoğlu, 2010).	Exclusion Criteria 1. This study is undertaken with young people aged 15 years old.
44. Control-value theory in the context of teaching: does teaching quality moderate relations between academic self-concept and achievement emotions? (Lazarides & Raufelder, 2021).	Exclusion Criteria 1. This study is undertaken with adolescents (Mean age: 14.58 years).
45. Establishing an Explanatory Model for Mathematics Identity (Cribbs et al., 2015).	Exclusion Criteria 1. This study is undertaken with college students.
46. Achievement Emotions and Academic Performance: Longitudinal Models of Reciprocal Effects (Pekrun et al., 2017).	Exclusion Criteria 1. This study is undertaken with adolescents.
47. Five principles of educationally rich mathematical games (Russo et al., 2018).	Exclusion Criteria 3. This is a literature review and no data collection occurs.
48. Integrating writing and mathematics: journaling to increase learning and enjoyment while reducing anxiety (McCarty & Faulkner, 2019).	Exclusion Criteria 1. This study is undertaken with college students.
49. Mathematics Sparks engagement programme: investigating the impact on under-privileged pupils' attitudes towards mathematics (ní Shuilleabhain et al., 2020).	Exclusion Criteria 1. This study is undertaken with secondary school pupils.
50. Attributional gender bias: teachers' ability and effort explanations for students' math performance (Espinoza et al., 2013).	Exclusion Criteria 1. This study is undertaken with adults only.
51. Indicators of middle school students' mathematics enjoyment and Confidence (Christensen & Knezek, 2020).	Exclusion Criteria 1. This study is undertaken with middle school pupils (aged 11-13).
52. It matters which class you are in: student-centred teaching and the enjoyment of learning mathematics (Noyes, 2012).	Exclusion Criteria 1. This study is undertaken with pupils aged 11-17.

53. Students' perceptions of mathematics writing and its impact on their enjoyment and self-confidence (Kaur & Prendergast, 2021).	Exclusion Criteria 4. This study is undertaken in India, which is not an OECD member state.
54. Math Comic Books to the Rescue: Can Wonderguy's Escapades Improve Children's Mathematics Attitudes? (Tassell et al., 2019).	Exclusion Criteria 1. This study is undertaken with children in grades 4-6 (10-12 year olds)
55. Pr.fadrifin kennsla og umhyggja fyrir staerdfraedinámi (Gíslason, 2023).	Exclusion Criteria 6. This study is not published in English.
56. Enjoyment in learning mathematics: its role as a potential barrier to children's perseverance in mathematical reasoning (Barnes, 2020).	Exclusion Criteria 1. This study is undertaken with children in upper primary (aged 10-11).
57. Instructional clarity and classroom management are linked to attitudes towards mathematics: A combination of student and teacher ratings (Chen, 2022).	Exclusion Criteria 1. This study is undertaken with adolescents (mean age 14.21 years).
58. A Pilot Movement Integrity with Intelligent Play Program (MIIP): Effects on Math Performance and Enjoyment for Preschoolers in China (Liang et al., 2023).	Exclusion Criteria 4. This study is undertaken in China, which is not an OECD member state.
59. Math selfefficacy or anxiety? The role of emotional and motivational contribution in math performance (Živković et al., 2023).	Exclusion Criteria 1. This study is undertaken with fifth grade students (mean age 10.36).
60. "Mathematics is like a lion": Elementary students' beliefs about mathematics (Markovits & Forgasz, 2017)	Exclusion Criteria 1. This study is undertaken with children in grades 4-6 (10-12 year olds).
61. Enjoyment of Chinese and mathematics and school performance in Chinese children and adolescents (Chen et al., 2023).	Exclusion Criteria 4. This study is undertaken in China, which is not an OECD member state.

62. Acute Effects of 5-Minute Dance Active Break on Executive Functions, Mathematics, and Enjoyment in Elementary School Children (Chatzopoulos et al., 2023).	Exclusion Criteria 1. This study is undertaken with children in upper primary.
63. The Search for Mathematical Creativity: Identifying Creative Potential in Middle School Students (Mann, 2009)	Exclusion Criteria 1. This study is undertaken with middle school pupils.

Appendix C: Summary of Included Studies

Mapping the Field

Author	Country	Participants (included in the review)	Research design	Intervention (where applicable)	Measures used	Main Findings
1. Collingwood & Dewey (2018)	United Kingdom	Primary school pupils (n=144)	Quantitative, between-group, repeated-measures experimental design	‘Thinking your problems away’ Mathematics intervention. This intervention was developed by the researchers. The intervention consisted of 12 sessions during a four week period, which included five key activities. These activities consisted of mindful breathing, using a thinking sheet to assist in working through Mathematics problems, modelling and peer talk, using jokes and comic strips and cognitive behavioural	**Access Mathematics** Test 1 (Form A and Form B) McCarty, 2008) **Mathematics Anxiety Scale** (OECD, 2005) **Scale of Mathematics Anxiety** (Cavanaugh & Sparrow, 2010). **Mathematics Self-Concept** (OECD, 2005) **Self-Concept in Mathematics** (Roebers et al., 2012) **Self-talk Questionnaire** (Lee, McDonough & Bird, 2014) **Classroom Behavioural Rating Scale** (CBRS; Matthews, Ponitz & Morrison, 2009)	The research findings indicated that differences in Mathematics performance and some Mathematics self-regulatory behaviours (Strategising and Focusing subsets), but no significant differences in Mathematics anxiety or self-concept.

				strategies such as utilising self-coping statements.		
2. Lichtenfeld et al. (2023)	Germany	Elementary school pupils (n=670)	Longitudinal cohort study	N/A	Achievement Emotions Questionnaire-Elementary School (AEQ-ES, Lichtenfeld et al., 2012) End of year grades obtained by pupils (based on several exams throughout the school year) Standardised Tests (MCT-ES) Trends in International Mathematics and Science study [TIMSS] (Martin et al., 2020)	Findings indicate a decline in Mathematics enjoyment as pupils progress through elementary school. No changes in pupils' boredom or anxiety related to completing tests were found. Pupil's learning-related anxiety declined when they progressed to Year 3, and remained stable.
3. Mata et al. (2021)	Portugal	Primary school students (n=71)	Longitudinal cohort study	N/A	Achievement Emotions Questionnaire for Elementary Students (AEQ-ES-P) Sanches et al. (2020) Portuguese Scale of Cognitive Level (Escala Colectiva de Nível Intelectual, ECNI) Grade reports (using a 4-point or 5-point Likert scale)	Findings indicate that enjoyment of pupils decreased over time while boredom of pupils increased.

4. Dowker et al. (2012)	England	Primary school pupils (n=89)	Cross sectional study	N/A	British Ability Scales (Basic Number Subtests) Mathematics Attitude and Anxiety Questionnaire Pictorial Rating Scales	Findings indicated small differences in year group attitudes. While no gender differences were reported in performance, boys reported themselves higher than girls did. Links between Self-Rating and Mathematics anxiety were found, whilst no connection between performance and Mathematics anxiety were found.
5. Syväoja et al. (2024)	Finland	Primary school pupils (n=397) Teachers (n=22)	Randomised Controlled Trial	The intervention consisted of a Physically Active Learning (PAL) group, a breaks group and a control group. The intervention lasted for between 18 and 20 weeks. It was due to last 22 weeks for all group, but the COVID-19 pandemic resulted in the premature termination of the intervention.	Modified version of the Fennema-Sherman Mathematics Attitude Scale (1976) validated for Finnish 3rd grade students (Metsämuuronen, 2014; Metsämuuronen & Tuohilampi, 2014) Abbreviated Math Anxiety Scale modified for children (mAMAS) (Carey et al. 2017) Körperkoordinationstest für Kinder (KTK) (Kiphard & Schilling, 2007)	Findings indicated that differences in Mathematics self-perceptions and enjoyment between the three groups were not found. Increases in Mathematics anxiety were present in the PAL group only.

					Movement Assessment Battery for Children-second edition (MABC-2) (Henderson et al., 2007) Eurofit test protocol (Tomkinson et al., 2018).	
6. Arens & Hasselhorn (2015)	Germany	Primary school pupils (n=156)	Cross sectional study	N/A	Self-Description Questionnaire (SDQ)I (Marsh, 1990a) Self-Rating Scale measuring effort	Findings indicated that a greater link exists between affect self-perceptions and effort, than between competence self-perceptions and effort.
7. Boliver & Capsada-Munsech (2021)	United Kingdom	Primary school pupils (n=8,876)	Longitudinal cohort study	N/A	Standardised Mathematics test (MCS Framework) Researcher-developed rating scale for pupils	Findings indicate that ability grouping adversely impacts pupil enjoyment of Mathematics in lower ability groups.
8. Marks (2016)	England	Primary school pupils (n=284)	Longitudinal Mixed Methods Cohort study	N/A	Attitudinal Questionnaire (Researcher-developed based on earlier work by Nicholls et al., 1990)	Findings indicate that pupil self-perceptions remain consistent. Pupils perceived Mathematics-related ability as an internal construct, which is biological in nature, rather than being influenced by external factors such as ability groupings.

9. Tomasetto et al. (2015)	Italy	Primary school pupils and their parents (n=253)	Mixed Methods Cross sectional design	N/A	Researcher-developed rating scale for parents, teachers and pupils.	Findings indicate that children's self-perceptions align with their perception of their parents' judgements relating to their mathematical ability, rather than the actual evaluations of their parents.

Appendix D: Weight of Evidence

Weight of Evidence A: Methodological Quality

The WoE A has been referred to as a generic judgement relating to the quality of the study (Gough, 2007), rather than its specific contribution to answering the review question. The WoE A evaluated the methodological quality of the 9 included studies using the Joanna Briggs Institute (JBI)'s Critical Appraisal Tools for Randomised Controlled Trials, Cohort Studies, Quasi-Experimental Studies and Cross-Sectional Studies (Joanna Briggs Institute, 2017). Using these tools allowed for an exploration for methodological quality, with a descriptive quality rating allocated to each of the included studies. The methodological quality for each study is depicted in Tables 1, 2, 3, 4.

Table 1 WOE A: Methodological Quality Criteria using JBI's Appraisal Tool for Randomised Controlled Trials

Syväoja et al. (2024)	
Was true randomization used for assignment of participants to treatment groups?	N
Was allocation to treatment groups concealed?	N
Were treatment groups similar at the baseline?	Y
Were participants blind to treatment assignment?	N
Were those delivering treatment blind to treatment assignment?	N
Were outcomes assessors blind to treatment assignment?	N
Were treatment groups treated identically other than the intervention of interest?	Y
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	Y
Were participants analyzed in the groups to which they were randomized?	Y
Were outcomes measured in the same way for treatment groups?	Y
Were outcomes measured in a reliable way?	Y

Was appropriate statistical analysis used?	Y
Was the trial design appropriate, and any deviations from the standard RCT design (individual randomization, parallel groups) accounted for in the conduct and analysis of the trial?	Y
WoE A Descriptive Quality Rating	MEDIUM (2)

Table 2 WOE A: Methodological Quality Criteria using JBI's Appraisal Tool for Quasi-Experimental Design

Collingwood & Dewey (2018)	
Is it clear in the study what is the 'cause' and what is the 'effect' (i.e. there is no confusion about which variable comes first)?	Y
Were the participants included in any comparisons similar?	Y
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Y
Was there a control group?	Y
Were there multiple measurements of the outcome both pre and post the intervention/exposure?	Y
Was follow up complete and if not, were differences between groups in terms of their follow up adequately described and analyzed?	N
Were the outcomes of participants included in any comparisons measured in the same way?	Y
Were outcomes measured in a reliable way?	Y
Was appropriate statistical analysis used?	Y
WoE A Descriptive Quality Rating	HIGH (3)

Table 3 WOE A: Methodological Quality Criteria using JBI's Appraisal Tool for Cross Sectional Studies

	Dowker et al. (2012)	Arens & Hasselhorn (2015)	Tomasetto et al. (2015)
Were the criteria for inclusion in the sample clearly defined?	Y	Y	Y
Were the study subjects and the setting described in detail?	Y	Y	Y
Was the exposure measured in a valid and reliable way?	N/A	N/A	N/A
Were objective, standard criteria used for measurement of the condition?	N/A	N/A	N/A
Were confounding factors identified?	N	N	N
Were strategies to deal with confounding factors stated?	N/A	N/A	N/A
Were the outcomes measured in a valid and reliable way?	Y	Y	Y
Was appropriate statistical analysis used?	Y	Y	Y
WoE A Descriptive Quality Rating	MEDIUM (2)	MEDIUM (2)	MEDIUM (2)

Table 4 WOE A: Methodological Quality Criteria using JBI's Appraisal Tool for Cohort Studies

	Lichtenfeld et al. (2023)	Mata et al. (2021)	Boliver & Capsada-Munsech (year)	Marks (2016)
Were the two groups similar and recruited from the same population?	Y	Y	Y	Y
Were the exposures measured similarly to assign people to both exposed and unexposed groups?	N/A	N/A	N/A	N/A
Was the exposure measured in a valid and reliable way?	Y	Y	Y	Y
Were confounding factors identified?	N	Y	Y	N
Were strategies to deal with confounding factors stated?	N/A	Y	Y	N/A
Were the groups/participants free of the outcome at the start of the study (or at the moment of exposure)?	Y	N/A	N/A	N
Were the outcomes measured in a valid and reliable way?	Y	Y	N	Y
Was the follow up time reported and sufficient to be long enough for outcomes to occur?	N	Y	Y	N
Was follow up complete, and if not, were the reasons to loss to follow up described and explored?	N	Y	Y	Y
Were strategies to address incomplete follow up utilized?	N/A	N/A	N/A	N/A

Was appropriate statistical analysis used?	Y	Y	Y	Y
WoE A Descriptive Quality Rating	MEDIUM (2)	HIGH (3)	MEDIUM (2)	MEDIUM (2)

Weight of Evidence B: Methodological Relevance

The WoE B evaluated the methodological relevance of included studies in the review. This refers to a judgement, specific to the review undertaken, relating to the study's capacity for providing evidence to answer the research question (Gough, 2007). Petticrew and Roberts (2003) typology of evidence was used to appraise the studies in this review. This framework for appraisal identifies Randomised Controlled Trials as most appropriate for determining efficacy (Petticrew & Roberts, 2003). The criteria and rationale employed to explore methodological relevance (WoE B) for each included study are displayed in Table 5.

Table 5 *Weight of Evidence B Petticrew and Roberts (2003) Typology of Evidence*

WOE B Rating and Criteria		
HIGH = 3 Randomized Control Trials (at student level) with: - A control group - Appropriate measures to assess pre, post intervention and control	MEDIUM=2 Quasi Experimental Study (Non-random assignment) with: - A control group - Appropriate measures to assess pre-, post-intervention and control -Evidence that assessment of differences between groups accounted for prior to commencement of intervention	LOW=1 Qualitative, Single Case and Non-Experimental Designs as effectiveness of an intervention to be measured appropriately is absent. Additionally, studies which have: - Not assessed pre- and post-intervention measures - No control groups - Limited sample sizes

Study	WOE B Rating given
Collingwood & Dewey (2018)	2= MEDIUM
Lichtenfeld et al. (2023)	1= LOW
Mata et al. (2021)	1= LOW
Dowker et al. (2012)	1= LOW
Syväoja et al. (2024)	3= HIGH
Arens & Hasselhorn (2015)	1= LOW
Boliver & Capsada-Munsech (2021)	1= LOW
Marks (2016)	1= LOW
Tomasetto et al. (2015)	1= LOW

Weight of Evidence C: Relevance of Evidence

WoE C is an appraisal which is specific to the review undertaken and assesses the relevance of evidence in each of the selected studies in answering the review question (Gough, 2007). When considering criteria for this specific review, it was decided to include: primary school setting, sample size, exploration of perceptions and enjoyment of pupils relating to Mathematics, evaluation of outcomes and attainment relating to these constructs. A rubric was utilised to score each of the studies considering their relevance in answering the review question. Studies considered to have high quality evidence were allocated a score of 3, medium relevance is characterised by a score of 2 and low relevance was categorised by a score of 1. Overall relevance of evidence was determined by calculating the mean score. This review was focused on exploring the propensity for mathematical self-perceptions and Mathematics enjoyment to impact the engagement and attainment of primary school pupils, and therefore these constructs were reflected as criteria in the WoE C. To include the potential for findings to be generalisable to the population, a sufficient sample size is requisite. Table 6 displays the total WoE ratings, which comprises the mean scores from the aforementioned criteria, consequently, the quality rating for each study included in the review.

Table 6 WOE C: Overall Relevance of Evidence rating scores and descriptive quality ratings

	Collingwood & Dewey (2018)	Lichtenfeld et al. (2023)	Mata et al. (2021)	Dowker et al. (2012)	Syväoja et al. (2024)	Arens & Hasselhorn (2015)	Boliver & Capsada-Munsech (2021)	Marks (2016)	Tomasetto et al. (2015)
Primary School Setting	3	3	3	3	3	3	3	3	3
Pre- and post-measures	3	1	1	1	3	1	1	1	1
Intervention	3	1	1	1	3	1	1	1	1
Sample size	3	3	2	2	3	3	3	3	3
Total	12	8	7	7	12	8	8	8	8
Total WoE C rating score (mean score of 4 criteria)	3	2	1.75	1.75	3	2	2	2	2
Total WoE C descriptive quality rating	HIGH	MEDIUM	MEDIUM	MEDIUM	HIGH	MEDIUM	MEDIUM	MEDIUM	MEDIUM

Scores of 2.5 and over are allocated a ‘high’ descriptive quality rating, scores of 1.5 to 2.4 are allocated a ‘medium’ descriptive quality rating and scores of between 1 and 1.4 are allocated a ‘low’ descriptive quality rating.

Weight of Evidence D: Overall Weighting

An overall weighting score (WoE D) is assigned to the nine studies included in the review. The mean scores derived from WoE A, WoE B and WoE C are taken into consideration and contribute to the evaluation of WoE D. A summary of WoE scores assigned to the studies which were included in the review is presented in Table 12. This table displays the methodological quality and relevance, relevance of evidence and the overall weighting score for each included study. Table 12 portrays the overall descriptive quality rating for each study included in the review. An overall high descriptive quality was identified in two studies (Collingwood & Dewey, 2018; Syväoja et al. 2024), and an overall medium descriptive quality was identified in seven studies (Lichtenfeld et al., 2023; Mata et al., 2021; Dowker et al., 2012; Arens & Hasselhorn, 2015; Boliver & Capsada-Munsech, 2021; Marks, 2016; Tomasetto et al., 2015). No overall low descriptive quality was identified.

Appendix E: Parent Plain Language Statement and Informed Consent

Research Title: Teacher and Pupil perspectives on mathematical self-perceptions and enjoyment in Irish primary school pupils

Student Researcher: Úna Shore; [redacted]
Research Supervisors: Dr. Aoife McLoughlin; *email: aoife.mcloughlin@mic.ul.ie*
Dr. Fionnuala Tynan; *email: fionnuala.tynan@mic.ul.ie*

What is the research about and why is it being conducted?
You are being asked to allow your son/daughter to take part in a research study to be conducted by Úna Shore and supervised by Dr. Aoife McLoughlin and Dr. Fionnuala Tynan, Mary Immaculate College. The study has been approved by the Mary Immaculate College Research Ethics Committee (MIREC). This study is being conducted for submission in partial completion of a Professional Doctorate in Educational and Child Psychology in Mary Immaculate College.

The purpose of this study is to explore teacher and pupil attitudes to self-perceptions and enjoyment of maths. The research aims to explore maths enjoyment and self-perceptions at first- and second- classes, to determine if there is a relationship between maths enjoyment and the transition to the next class level. The research aims to explore the impact of the redeveloped Maths curriculum on teaching, pupil enjoyment and self-perceptions relating to Maths.

What is involved?
This is a school-based study, which will involve completing survey-based research. Your son/daughter will be asked to complete a short survey with the researcher in October 2024. The surveys are completed anonymously. Your son/daughter may be selected to engage in a short (less than 30 minutes) small group discussion with the researcher, which is based on the mosaic approach (Clarke & Moss, 2011). This approach is a child-friendly process which involves gathering information regarding their lived experience of maths using photographs, maps and drawings. Your child will use these to guide the discussion with the researcher.

Does my son/daughter have to take part?
This research is completely voluntary which means that your child does not have to take part. If you or your child would prefer that they did not participate, this is completely fine.

If you choose to provide consent after reading this information sheet, your child will be given a plain language statement explaining what is involved in the research project in child-friendly terms and language. Your child will be asked to provide their assent, by ticking the relevant box. Participation in this research project is completely voluntary. Your child may refuse to answer individual questions or to engage in individual or group activities. You and your child may choose to discontinue all participation in this study at any time.

Are there any benefits from taking part and are there any risks involved?
This study may contribute to our understanding of the experiences of primary school children relating to maths, specifically children in first- and second- classes, which may indirectly benefit your child's education. You will not be provided with information as to your child's performance on any of the study tasks. There are no major risks associated with this project. In the unlikely event that you or your child should become distressed during the completion of the survey, they may choose to withdraw from completing the survey. The researcher's details are listed above and parents may contact the researcher at any point throughout the research process, should they be concerned.

How will data be handled?
The data collected for this research project will be in the form of survey responses, child drawings/photographs/maps and audio recordings. The data collected in this research project will be kept confidential. Your child's name will not be collected with the data, and all data will be stored securely on Microsoft Outlook. Reports of this study will not include individual data in a form by which your child could be identified. Data from this study will be stored on Mary Immaculate College OneDrive, and destroyed once it has been uploaded to SPSS as per GDPR guidelines. Any identifiable information (e.g., your child's name, contact information, etc.) will be stored separately for the duration of the research at which point it will be destroyed. Data will not be shared with any outside bodies subject to legal limitations.

If you should have any questions either before consenting, or during the completion of the project, please contact either the project supervisor or student researcher using the contact details provided on the previous page.

If participants have concerns about this study and wish to contact an independent person,
please contact:
MIREC Administrator
Mary Collins
+ 353 61 204980
Mirec@mic.ul.ie

Parent Consent
Mary Immaculate College

Informed Consent Form- Parents/Guardians

Research Title: Teacher and Pupil perspectives of mathematical self-perceptions and enjoyment in Irish primary school pupils**.**

Student Researcher: Ú́na Shore; *email:* [redacted]
Research Supervisors: Dr. Aoife McLoughlin; *email: aoife.mcloughlin@mic.ul.ie*
Dr. Fionnuala Tynan; *email: fionnuala.tynan@mic.ul.ie*

The purpose of this study is to explore teacher and pupil perspectives of maths self-perceptions and enjoyment in Irish primary school. The study will utilise a survey and small group discussion to explore these perceptions. The small group discussion is underpinned by the Mosaic approach (Clarke & Moss, 2011), which is a child-friendly approach to capturing the lived experience of the child. Your child may be chosen to participate in this aspect of the research, which will involve your child bringing the researcher on a tour of the school and taking pictures that they associate with maths in the school environment. The researcher is fully vetted and a member of staff (teacher or SNA) will be invited to accompany the children for the duration of their participation in the study. A safeguarding statement has been prepared to ensure your child's safety is central throughout the research process. Your child will be encouraged to create drawings and maps relating to maths enjoyment and self-perceptions. They will combine the photographs, drawings and maps, using these to prompt their discussion of maths enjoyment and self-perceptions.

Please read the following statements and tick your answer.

	Yes	No
I have read the Plain Language Statement/Information Sheet (or had it read to me)	○	○
I understand all of the information provided	○	○
I have had an opportunity to ask questions and discuss this study		

*(**NOTE:** researchers' details are included above for contacting with questions)* ○ ○

I understand that participation is completely voluntary and that I/my child can withdraw from the study at any point without penalty Yes ○ No ○

I understand that the data collected during this study will be kept in a confidential location subject to legal limitations Yes ○ No ○

I understand that the information I provide will be used for the researcher's completion of a doctoral programme and may be submitted for publication and/or presented at conferences. The information will remain anonymous and unidentifiable in these circumstances. Yes ○ No ○

I have read and understood the information in this form. My questions and concerns have been answered by the researchers, where necessary, and I have a copy of this consent form. Therefore, I consent for my child to take part in this research project.

<u>Consent</u>

I consent to my child's participation Yes ○ No ○

If participants have further questions about this study or their rights, or if they wish to lodge a complaint or concern, they may contact:

Úna Shore
Email [redacted]

If participants have concerns about this study and wish to contact an independent person,
please contact:

MIREC Administrator
Mary Collins
+ 353 61 204980
Mirec@mic.ul.ie

Appendix F: Plain Language Statement (Child)

	I am looking for pupils to take part in a project all about maths. It will explore your enjoyment of maths and what you think about yourself completing maths activities. It might help us to understand what helps pupils to become more comfortable with maths tasks and activities.
	Here is some information about what will happen in the research.

	Maths Enjoyment means how happy we feel when we engage in maths activities. For some people this will be really high, for others it might not be so high. Everyone enjoys maths a different amount and that is ok! Maths Self-Perception means what you think about your own ability and skills when you are completing maths activities. This will be different for everyone too and that is ok!
	You will answer some questions about your self-perceptions about maths and enjoyment of maths. I will read out the questions to you. If you need me to say one again, just ask!

	It should take about 10 minutes for you to complete the survey.
	Some of you might show me around your school and bring me to things that make you think of maths enjoyment and completing maths activities. You might take some photos and draw some pictures. You might chat with me in a small group about the photos and pictures.
	If you do not feel comfortable taking part in the survey or taking part in the chat with me about maths, you can stop straight away.

 	I will write about the survey and small groups in my project, but I will never use your name.
	I will keep the information in a safe place where nobody else can look at it.

	I will keep the information for 5 years in case I write about the project again. After this, I will safely delete the information.
	If you and your parent(s)/ guardian(s) have any other questions about the project, please contact the researcher: **Name:** Úna Shore ***email address:*** [redacted] **<u>Or</u>** If you and/or your parent(s)/guardian(s) have concerns about this project and wish to contact an independent person, please contact: *MIREC Administrator* *Mary Collins* *+ 353 61 204980* Mirec@mic.ul.ie

Appendix G: Informed Consent (Child)

Mary Immaculate College

Children's Assent Form to Participate in Research
Teacher and Pupil perspectives on mathematical self-perceptions and enjoyment in Irish primary school pupils

I ______________________________ agree to take part in a project about my enjoyment of maths and what I think about maths and me. My parent/carer has agreed for me to take part in the project as well.

Please place a tick in each box if you understand the sentence, or an X in each box if you do not understand the sentence.

I know: ✓ ✗

- It is ok for me to stop being part of the project whenever I want to. ☐
- I know what to do but I can ask them to explain again if I am unsure. ☐
- If anything during the project makes me feel upset, I can stop. ☐
- The researchers won't tell anyone that I took part in the research project. ☐
- The only time the researchers would have to tell someone else is if they were worried:
  - that I might be badly hurt by someone
  - that I am not being cared for properly

- that I might hurt myself or
- that I might hurt someone else

If I have any questions I can contact the researchers. ☐

I would like to take part in the survey, and I know that I might be chosen for a small group discussion.

○ Yes ○ No

Appendix H: Pupil Survey

Teacher and Pupil perspectives on mathematical self-perceptions and enjoyment in Irish primary school pupils

I am in:

- **1st class**
- **2nd class**

I am a:

- **Girl**
- **Boy**

Math and Me Survey (Adelson & McCoach, 2011)

Mathematics Self-Perceptions

1. I think I am really good at math.	Never Rarely Sometimes Often Regularly
2. I understand math.	Never Rarely Sometimes Often Regularly
3. I can solve difficult math problems.	Never Rarely Sometimes Often Regularly
4. Math is very hard for me.	Never Rarely Sometimes Often Regularly
5. Math is confusing to me.	Never Rarely Sometimes Often Regularly
6. Math comes easily to me.	Never Rarely Sometimes Often Regularly
7. I can tell if my answers in math make sense.	Never Rarely Sometimes Often Regularly
8. Doing math is easy for me.	Never Rarely Sometimes Often Regularly

Mathematics Enjoyment

1. I love math.	Never Rarely Sometimes Often Regularly
2. Math is boring.	Never Rarely Sometimes Often Regularly
3. I enjoy doing math puzzles.	Never Rarely Sometimes Often Regularly

4. I do math problems on my own "just for fun."	Never Rarely Sometimes Often Regularly
5. Math is fun.	Never Rarely Sometimes Often Regularly
6. I look forward to learning new math.	Never Rarely Sometimes Often Regularly
7. I hate math.	Never Rarely Sometimes Often Regularly
8. I enjoy playing math games.	Never Rarely Sometimes Often Regularly
9. I enjoy studying math.	Never Rarely Sometimes Often Regularly
10. Solving math problems is fun.	Never Rarely Sometimes Often Regularly

***Researcher will complete examples with the children before administering the survey. Researcher will discuss the potential responses with the children and emphasise that they feel like this Never, Rarely, Sometimes, Often, Regularly**

Examples:

I like playing football	Never Rarely Sometimes Often Regularly
I can do a cartwheel	Never Rarely Sometimes Often Regularly
I hate colouring	Never Rarely Sometimes Often Regularly
I enjoy making my own lunch	Never Rarely Sometimes Often Regularly
I can tell if my room is tidy	Never Rarely Sometimes Often Regularly

Appendix I: Mosaic Approach

Stage One - Information Gathering

- **"Maths Walk"**
  Children will conduct a walking tour of their school, drawing attention to the aspects of their school that they associate with maths and maths learning. The children will use iPads to document the different places in their school that they associate with maths.

  Prompts:
  1. What places around the school do you think of when you think about maths?
  2. Can you show me some places that come into your mind when you think about maths?

- **Drawing their ideal maths lesson**
  Children will be encouraged to discuss what maths lessons they have enjoyed the most and which have been most beneficial for their learning. Children will be encouraged to think about the lessons and activities they have enjoyed the most and draw their ideal maths lesson.

  Prompts:
  1. What was your favourite maths lesson?
  2. What kind of activities do you enjoy doing in maths?
  3. Have maths lessons changed since you went into first/second class? How?

- **Map of Maths**
  Children will be encouraged to create a maths map, including "Maths at my Desk", "Maths in my Classroom", "Maths in my School" and "Maths in Other Places" detailing what aspects of maths they associate with each part of the map.

  Prompts:
  1. When you are sitting at your desk, what kind of things do you do that make you think of maths? What kind of things are at your desk that help you with maths?
  2. What kind of things in your classroom make you think of maths? What helps you the most with maths in your classroom?
  3. What is maths like for you in school?
  4. Do you use maths outside of school? Where?

Stage Two - Sharing and Interpretation of Information

When the children have conducted the maths walk, completed the ideal maths lesson and map of maths, they will sit with the researcher and look at the information they have gathered collectively. The researcher will discuss the information with the children and explore their experiences of maths.

Prompts:

1. Looking at all the information that we have gathered, what are the most important pieces to you?
2. Looking at all the information we have gathered, what do you think makes maths enjoyable?
3. Looking at all the information we have gathered, what kind of things help you to feel confident about maths activities?

Stage Three - Discussing the future

Children will discuss aspects of the approach to maths that they like and what they could potentially include to improve their experiences.

Prompts:

1. What parts of maths in school do you think work really well?
2. What do you think could be included to make maths even better and more enjoyable in school?

Appendix J: Teacher Informed Consent

Teacher Consent
Mary Immaculate College

Informed Consent Form- Teachers

Research Title: Teacher and Pupil perspectives on mathematical self-perceptions and enjoyment in Irish primary school pupils
Student Researcher: Úna Shore; *email*[redacted]
Research Supervisors: Dr. Aoife McLoughlin; *email: aoife.mcloughlin@mic.ul.ie*
Dr. Fionnuala Tynan; *email: fionnuala.tynan@mic.ul.ie*

The purpose of this study is to explore teacher and pupil perspectives of maths self-perceptions and enjoyment in Irish primary school. The study will utilise a pupil survey and an exploration of the lived experience of the child. The survey utilises items from the Math and Me survey (Adelson & McCoach, 2011), which explores maths enjoyment and mathematical self-perceptions. This survey will be completed at the whole-class level, with all children invited to participate. Children whose parents have consented will be withdrawn in small groups of no more than 8 by the researcher. The researcher will provide details of the research project to the children and seek their assent. Children who provide assent will remain with the researcher. The researcher will administer the Math and Me survey items. Children will provide responses using iPads. This should take no more than 20 minutes per group. Children whose parents have not provided consent, or who have chosen themselves not to participate will remain in the classroom with you during the administration of the survey.

Children's perspectives will be explored using the Mosaic approach (Clarke & Moss, 2011), which is a child-friendly approach to capturing the lived experience of the child. You will be asked to select three children in your class to participate in this aspect of the research, which will involve the child bringing the researcher on a tour of the school and taking pictures that they associate with maths in the school environment. Children will be encouraged to create drawings and maps relating to maths enjoyment and self-perceptions. They will combine the photographs, drawings and maps, using these to prompt their discussion of maths enjoyment and self-perceptions.

You will be asked to fill out an online questionnaire regarding your experience of pupil mathematical self-perceptions and maths enjoyment. Mathematical self-perceptions refer to a child's perceptions of themselves relating to maths, inclusive of themselves as a mathematical learner, their abilities to learn and achieve in mathematics. Maths enjoyment refers to the extent to which a child derives pleasure from engaging in maths activities. This online questionnaire will explore the impact of the recently Redeveloped Maths Curriculum.

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MARY IMMACULATE COLLEGE
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Please read the following statements and tick your answer.

	Yes	No
I have read the Plain Language Statement/Information Sheet (or had it read to me)	○	○
I understand all of the information provided	○	○
*I have had an opportunity to ask questions and discuss this study (**NOTE:** researchers' details are included above for contacting with questions)*	○	○
I understand that participation is completely voluntary and that I can withdraw from the study at any point without penalty	○	○
I understand that the data collected during this study will be kept in a confidential location subject to legal limitations	○	○
I understand that the information I provide will be used for the researcher's completion of a doctoral programme and may be submitted for publication and/or presented at conferences. The information will remain anonymous and unidentifiable in these circumstances.	○	○

I have read and understood the information in this form. My questions and concerns have been answered by the researchers, where necessary, and I have a copy of this consent form. Therefore, I consent to participating in this research project.

Consent

	Yes	No
I consent to my participation	○	○

If participants have further questions about this study or their rights, or if they wish to lodge a complaint or concern, they may contact:

Úna Shore
Email:[redacted]

If participants have concerns about this study and wish to contact an independent person,
please contact:

MIREC Administrator
Mary Collins
+ 353 61 204980
Mirec@mic.ul.ie

Appendix K: Phase 5 Codebook

Codes\\Phase 5 - Refining, Defining and Naming Themes

Name	Description	Sources	References
1. Teaching and Learning	Teaching Practices, Pupil Experiences and Changes in Mathematics Experiences	60	435
1.1 Pupil Experiences	Relating to mathematical experiences of pupils, positive or negative	7	145
Fun experiences	Experiences pupils refer to as fun or enjoyable.	5	22
Gamification	References to games in learning experiences	4	15
Learning Experiences	Relating to learning experiences of pupils	7	131
Pupil Preferences	Experiences/Resources pupils have a preference for	2	18
1.2 Teaching Practices	Methodologies and Strategies implemented within classrooms during the teaching and learning of mathematics	8	51
1.3 Changes in Mathematics experiences	Changes in teaching and learning experiences, inclusive of those relating to the Redeveloped Curriculum	7	25
Changes in Curriculum	Curriculum-related changes noted by teachers/pupils	7	16
Changes in Mathematics Learning	Changes noted by pupils/teachers relating to pupil experiences	6	12
2. Attitudes towards Mathematics	Positive or Negative Attitudes towards Mathematics (learning or application)	7	80
2.1 Positive Attitudes	Positive comments related to teaching and learning of Mathematics	7	57
2.2 Negative Attitudes	Negative Attitudes towards the teaching and learning of Mathematics	2	15
2.3 Teacher attitudes	Attitudes towards teaching Mathematics	1	3
3. Resources	Helpful resources inclusive of school staff, materials, time and barriers to accessing resources	6	81

Name	Description	Sources	References
3.1 People as Resources	Teacher, Family Members, Friends	6	23
3.1 Teacher as Resource	References to Role of Teacher in classroom	4	18
3.2 Family members as Resources	References to parents, siblings, grandparents etc.	2	5
3.2 Materials	All materials relating to mathematics learning	9	40
Books as resource	References to using books, copybooks etc.	1	2
Concrete materials	Reference to concrete materials as resource	4	30
Games as resources	References to games used during mathematics lessons	1	10
Technology	Technology as a resource	3	8
3.3 Teaching Strategies	Strategies as a resource for facilitating learning	3	7
3.4 Resourcing Challenges	Challenges relating to teacher shortage, lack of physical resources, lack of time	3	4
4. Pupil Specific Characteristics	Qualities including resilience, self-awareness and having a growth-mindset	4	32
4.1 Resilience	Pupils reference to challenges and overcoming challenges in Mathematics	1	7
4.2 Growth mindset	Relating to positive attitudes towards challenges	2	12
4.3 Confidence	References to pupil confidence relating to mathematics	3	6
4.4 Self-Awareness	Reflective comments indicating self-awareness	2	6

Appendix L: Ethical Approval

MIREC-5, Created November 2021

MIREC-5

Research Ethics Committee

MIREC Final Decision Form

APPLICATION NUMBER:	A24-051

PROJECT TITLE: Teacher and Pupil Perspectives on Maths Self-perceptions and Enjoyment in Irish Primary School Pupils

1.

2. APPLICANT

Name:	Úna Shore
Department / Centre / Other:	EPISE
Position:	Postgraduate Researcher

3. DECISION OF MIREC CHAIR (✓)

☐	Ethical clearance through MIREC is not required and therefore the applicant need take no further action in this regard.
✓	Ethical clearance is required and is hereby granted by the Chair without need for referral to the MIREC committee.
☐	Ethical clearance for a funding application or a similar purpose is granted by the Chair ***pro tem*** without need for referral to the MIREC committee. However, the applicant must subsequently seek ethical clearance from MIREC prior to embarking on any related project work involving human participants or their data.
☐	Ethical clearance is granted following review of the application by the MIREC committee.
☐	Ethical clearance is not granted following review of the application by the MIREC committee.

4. REASON(S) FOR DECISION

I have reviewed this proposal and I am satisfied it meets MIREC requirements. Safeguarding statement is fit-for-purposed. The application is, therefore, approved.

5. SIGNATURE OF MIREC CHAIR

Name (Print):	Dr Marie Griffin
Signature:	
Date:	4th October 2024