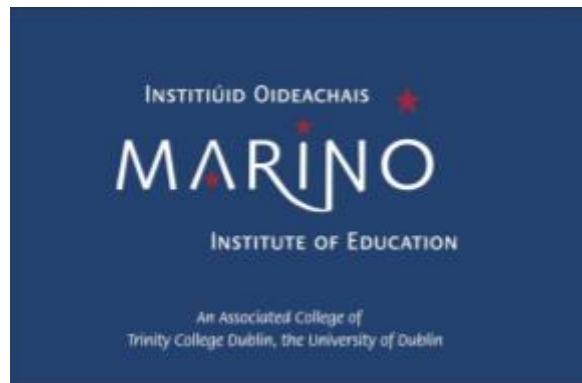




Singing Sums: Investigating the Integration of Song Singing in the Teaching and Learning of Mathematics from Junior Infants to Second Class

Marino Institute of Education

Name: Clodagh Ní Dhaltúin

Student Number: 16321558

Word Count: 10, 743

Supervisor: Richard Coady

Date of Submission: 9th May 2022

This dissertation is submitted in fulfilment of the requirements for the Professional Master of Education, Marino Institute of Education

Declaration

I hereby certify that this material, which I now submit for assessment on the programme leading to the award of the degree of Professional Master of Education, is entirely my own work and has not been taken from the work of others, save to the extent that such work has been cited and acknowledged within the text of my work. I further declare that this dissertation has not been submitted as an exercise for a degree at this Institute and any other Institution or University. I agree that the Marino Institute of Education library may lend or copy the thesis, in hard or soft copy, upon request.

Printed Name: Clodagh Ní Dhaltúin

Date: 9th May 2022

MIE Thesis Deposit License

In accordance with the *Copyright and Related Rights Act, 2000 and S.I. 427 of 2000* I hereby give permission to the Marino Institute of Education to make available, at their discretion, for consultation, inter-library lending or copying the thesis detailed above. I agree that the Marino Institute of Education may deposit the thesis detailed above in the Institutional Repository managed by the Library and or in *Tara*, the Institutional Repository managed by Trinity College and if appropriate into *Arts and Culture in Education Research Repository* (ACERR). I confirm that the electronic copy consists of one PDF file mirroring the hardbound copy. I understand that the metadata (title, author, abstract, key words) pertaining to all theses, including those under embargo, will be made available in the MIE Institutional Repository and *Tara*, and on the Library catalogue and in any list of theses published by the Institute or to which the Institute may decide to contribute.

De réir an *Copyright and Related Rights Act, 2000 agus Ionstraim Reachtuil 427 de 2000*, tugaim leis seo cead d'Institiúid Oideachais Marino an tráchtas thuasluaite a chur ar fáil, faoina rogha féin, don bhreathnú, d'iasachtaí idir-leabharlainne nó do chóipeáil. Aontaím gur féidir le hInstitiúid Oideachais Marino an tráchtas thuasluaite a chur sa Stór Institiúideach a ndéanann an Leabharlann bainistíocht air, nó i gCartlann Taighde Choláiste na Tríonóide (TARA), an Stór Institiúideach a ndéanann Coláiste na Tríonóide bainistíocht air, agus más cuí, an tráchtas a chur i Stór an Taighde ar na hEalaíona agus ar an gCultúr san oideachas, nó ACERR mar is fearr aithne air sa Bhéarla. Deimhním gur comhad PDF amháin atá sa chóip leictreonach macasamhail na cóipe faoi chumhdach crua. Tuigim go mbeidh na meiteashonraí (teideal, údar, achoimre, eochairfhocail) a bhaineann leis na tráchtais ar fad, lena n-áirítear cinn faoi lánchosc, go mbeidh na meiteashonraí sin ar fáil sa Stór Institiúideach de chuid Institiúid Oideachais Marino agus TARA, ar chatalóg na Leabharlainne, agus in aon liosta tráchtas a fhoilsíonn an Institiúid nó ar liosta a gcuireann an Institiúid leis.

http://www.achtanna.ie/result.html?q_phrase=Copyright+and+Related+Rights+Act%2C+2000+&hits_per_page=25&button=Search

Signature: Clodagh Ní Dhaltúin

Date: 9th May 2022

Abstract

This dissertation investigates the integration of song singing in the teaching and learning of mathematics from junior infants to second class. The researcher aims to provide critical insights into the perspectives and experiences of Irish primary teachers on using song singing in primary school and how song singing can be integrated into the teaching and learning of mathematics in the junior classes. At a time when the current Primary Mathematics Curriculum is being redeveloped, it is pertinent to address the opportunities for integration across the new curriculum.

Through a comprehensive review of the literature, the researcher identifies key themes that relate to song singing, mathematics, and integration in the junior classes of primary school. By adopting a qualitative methodology, the researcher conducts semi-structured interviews with a purposive sample of Irish primary teachers, to collect data that relates to the themes presented in the literature. The findings of this study indicate that song singing is used by teachers, both outside of and across the primary curriculum. A range of benefits in using it in the teaching and learning of mathematics in the junior classes also came from the data, such as song singing for memorisation, engagement, and relatedness to children's lives. Some challenges also came from the data, such as a teacher's lack of song singing confidence, a lack of readily available song singing and mathematical resources, and the pressure of having to complete the mathematics textbooks, which can inhibit opportunities for integrated and inclusive lessons.

However, as recommended by the researcher, these challenges can be addressed through the development of Continuous Professional Development (CPD) courses and the development of readily available song singing and mathematical resources to support primary teachers in this opportunity for integration.

Key Words: integration, music, song singing, mathematics, primary school, curriculum, junior classes, Ireland

Acknowledgments

I would like to take this opportunity to express my sincerest gratitude to my supervisor, Richard Coady, for his continuous support and patience during the completion of this research study. His invaluable advice and professional guidance have been hugely appreciated throughout the year and have taught me a lot about education and research. Richard went above and beyond to support me throughout all aspects of the research study, and I am very grateful for that.

Similarly, I would also like to thank Dr. Clíodhna Martin who prepared us for the completion of this research study. From the start of the Research Methods module. Clíodhna has always been there to provide support and assistance in any way. The commitment that she has to her students and their work is phenomenal and is something that I admire and wish to take with me into my own future career.

I would also like to thank my Mum for her encouragement and constant support throughout the PME, and to my friends who helped me to get through the last two years – I couldn't have done it without you.

Also, I wish to thank all the other lecturers that I engaged with over the last two years of the PME, for sharing their skills and expertise in their subject area. I was particularly inspired by Breed Murphy's Mathematics lectures and Dr. Máire Nuinseann's music lectures during the completion of this research project.

To protect anonymity, the participants of the research project cannot be named but I do wish to take this opportunity to thank them for their contribution to this study. All the participants were hugely supportive in the completion of this dissertation and provided invaluable insights that were fundamental in the completion of the project.

Table of Contents

Declaration.....	ii
MIE Thesis Deposit License.....	iii
Abstract.....	iv
Acknowledgments.....	vi
Table of Contents.....	vii
List of Tables	ix
List of Abbreviations	x
Chapter One: Introduction	1
Research Context	1
Research Questions.....	2
Dissertation Outline	2
Chapter Two: Literature Review	3
Introduction.....	3
Song Singing in Primary School.....	3
<i>The Challenges of Using Song Singing in Primary School.....</i>	<i>4</i>
<i>Song Singing for Neurological and Memorisation Developments.....</i>	<i>5</i>
Mathematics in Primary School.....	6
<i>The Mathematics Curriculum in the Junior Classes.....</i>	<i>6</i>
<i>How Children Learn Mathematics in the Junior Classes</i>	<i>7</i>
Integration in Primary School	8
<i>The Theory of Integration</i>	<i>8</i>
<i>The Integration of Song Singing in the Teaching and Learning of Mathematics in the Junior Classes: Theory and Practice</i>	<i>10</i>
Conclusion	14
Chapter 3: Research Methodology	15
Introduction.....	15
Research Methodology	15
Research Method	16
<i>Sampling</i>	<i>16</i>
<i>Interviews.....</i>	<i>17</i>
Data Analysis.....	19
Ethical Considerations	20
Limitations and the Positionality of the Researcher	21
Conclusion	22
Chapter 4: Data Analysis	23

Introduction.....	23
Song Singing in Primary School.....	23
<i>Teachers' Use of Song Singing – Outside of the Curriculum</i>	23
<i>Teachers' Use of Song Singing – Across the Curriculum</i>	24
The Benefits of Using Song Singing in the Teaching and Learning of Mathematics in the Junior Classes	26
<i>Song Singing for the Memorisation and Solidification of Mathematical Principles, Facts, and Concepts</i>	27
<i>Song Singing for Mathematical Engagement and Enjoyment</i>	28
<i>Song Singing for Mathematical Relatedness and Connectedness to Children's Lives</i>	29
The Challenges of Using Song Singing in the Teaching and Learning of Mathematics in the Junior Classes	30
<i>Teacher's Experiences in the Classroom</i>	31
<i>The Availability of Song Singing and Mathematical Resources</i>	31
<i>The "Textbook Teaching" of Mathematics</i>	33
Responding to the Challenges of Using Song Singing in the Teaching and Learning of Mathematics in the Junior Classes.....	33
<i>Continuous Professional Development (CPD) Courses</i>	34
<i>The Development of Song Singing and Mathematical Resources</i>	34
Conclusion	35
Chapter 5: Conclusions and Recommendations	36
Introduction.....	36
Recommendations for Educational Practice and Policy	36
Areas for Further Research	37
Final Conclusion	38
References.....	39
Appendices.....	50
Appendix A: NCCA Music Curriculum	50
Appendix B: NCCA Mathematics Curriculum	51
Appendix C: Letter of Invitation.....	52
Appendix D: Information Letter	53
Appendix E: Consent Form	54
Appendix F: Interview Schedule	55
Appendix G: Sample of Interview Transcript.....	56
Appendix H: Ethical Approval	58
Appendix I: Linking Literature Review and Data Analysis Themes	59

List of Tables

Table 1: Examples of Some Mathematical Songs in Literature Linked to Mathematical Strands, Strand Units, and Concepts from the current NCCA Mathematics Curriculum for the Junior Classes.....	11
Table 2: Details of Participants.....	16
Table 3: The Integration of Song Singing Across the Curriculum.....	25

List of Abbreviations

BERA	British Educational Research Association
CPD	Continuous Professional Development
DES	Department of Education and Skills
EMA	Early Mathematical Activities
NCCA	The National Council for Curriculum and Assessment
NRC	National Research Council
PDST	Professional Development Service for Teachers
PME	Professional Master of Education
UK	United Kingdom

Chapter One: Introduction

Research Context

The NCCA is currently reviewing and redeveloping the Irish primary school curriculum. Since the curriculum's development in 1999, it has supported and guided teachers in teaching and learning across all primary school subjects. However, it is time for a change. The NCCA (2019) has acknowledged that it is time to move away from looking at subjects in isolation, and instead to look towards a more integrated curriculum. In order to facilitate an integrated curriculum, it is fundamental to observe what subjects can be successfully and effectively integrated to promote high-quality teaching and learning experiences in primary school. One such opportunity for integration is between music and mathematics (Dooley et al., 2014).

As put by Helmholtz in Fauvel et al. (2006), “mathematics and music, [are] the most sharply contrasted fields of intellectual activity which can be found, and yet related, supporting each other, as if to show forth the secret connection which ties together all the activities of our mind” (p. 122). The natural connection between these two disciplines can offer teachers rich educational opportunities to facilitate high-quality teaching and learning. This is where the rationale for this research study came about.

The researcher has always had an interest in mathematics and studied mathematics at a university level as part of a Business and Economics degree. On the other hand, the researcher has always had a passion for music and loves to share this passion with others and bring music into her teaching and learning practices in the classroom whenever possible. Therefore, by combining these two interests, music and mathematics, the researcher set out to investigate how these two disciplines could be integrated across primary school. Given the scope of musical concepts and elements that can be used across teaching and learning in

primary school, the researcher decided to settle on one musical element – song singing, which is “the first and most accessible instrument for the child” (NCCA, 1999a, p. 6). In addition to this, the researcher decided to focus the study on mathematics from junior infants to second class, which are considered to be the junior classes of primary school. The researcher’s classroom experience predominantly lies within the junior classes, and it is in these years that the development of mathematical proficiency begins (Dooley et al., 2014).

Research Questions

In order to investigate the integration of song singing in the teaching and learning of mathematics from junior infants to second class, a qualitative research study was carried out. The researcher aimed to provide critical insights into the perspectives and experiences of Irish primary teachers on using song singing in primary school [also referred to as the classroom], and how song singing can be integrated into the teaching and learning of mathematics from junior infants to second class [also referred to as the junior classes]. The researcher also aimed to provide recommendations for the development of educational policy and practice and to recommend areas for further research into the integration of music and mathematics.

Dissertation Outline

This research study is made up of five chapters. Chapter one introduces and briefly outlines the research context, research question, and aims of this study. Chapter two provides a review of the current literature in relation to this topic. Chapter three discusses the methodologies used to approach this study. Chapter four provides a critical analysis of the main findings of the study, referring to the data gathered from a sample of participants and the relevant literature. Finally, chapter five presents the conclusions of this study and provides recommendations for further research and areas for development across educational policy and practice.

Chapter Two: Literature Review

Introduction

This chapter provides an insight into some of the leading literature that relates to song singing in primary school, the teaching and learning of mathematics in the junior classes of primary school, and the opportunities for integration that can arise between these two areas in these junior classes. Published literature from a national and international lens was addressed, and themes were chosen to discuss and explore the main ideas, issues, and findings related to this topic.

The first theme relates to song singing in primary school. The researcher looks at the challenges of using song singing in primary school and how song singing can facilitate neurological and memorisation developments in the brain. The second theme relates to mathematics: how mathematics for the junior classes is outlined in the current curriculum, and how children learn mathematical skills and dispositions in the junior classes. The final theme looks at integration: how integration can be implemented in primary school and how song singing, and mathematics have been previously integrated across theory and practice. The literature outlines the benefits associated with this opportunity for integration, suggesting it as a valuable approach to teaching and learning in primary school.

Song Singing in Primary School

The notion of song has often been used to describe a piece of any kind of music, however, in this paper, song singing will be solely related to “voiced musical sounds” (Stadler Elmer, 2011, p. 768). As shown in Appendix A, the music curriculum for the junior classes is comprised of three strands, and song singing is identified as a strand unit of the performing strand. Song singing within the music curriculum has been outlined as “a vital aspect of a child’s early musical development” (NCCA, 1999a, p. 6). This statement can be

seen to be formulated on a basis similar to that of Geist et al. (2012), who identified that before most children even reach a school-going age, music has often already become a natural part of their lives and that in line with Samsudin et al. (2019), it is very common for young children to love music. This can make song singing “the first and most accessible instrument for the child” (NCCA, 1999a, p. 6), suggesting it as an attainable pedagogy to use in primary school. Levinowitz (1999) also supports this statement made by the NCCA, by outlining how song singing is always readily available and that it can be used at any time in the classroom.

The Challenges of Using Song Singing in Primary School

Although music is a mandatory subject in the primary curriculum, Richards (1999), Hennessy (2000), and other scholars have identified that some teachers could have low confidence levels in conducting musical activities, such as song singing. Some primary teachers perceive that music requires “specialist knowledge and skills”, which some teachers proclaim to lack (Kerin, 2019, p. 51). A study conducted by Hennessy (2000) suggested that this confidence deficit or musical ignorance amongst teachers could arise from many factors including “prior personal experience, university course, or school-based experience” (p. 187). This lapse in musical confidence amongst primary teachers was addressed in the UK through the *Department of Education’s National Plan for Music Education* (2011), which aimed to increase the number of primary teachers able to teach music and for teachers with musical expertise to become subject leaders (Hennessy, 2017). There have been some efforts made in Ireland to promote the teaching of music in primary schools, such as the DES (2012) *Arts in Education Charter* or the *Creative Ireland Programme 2017-2022* (Creative Ireland, 2021). However, neither policy identifies the confidence deficit that exists for Irish primary teachers in their delivery of musical activities such as song singing in the classroom. Instead, these policies focus on schools’ partnerships with outside agencies such as *Creative Schools* or

Music Generation (Creative Ireland, 2021), rather than trying to address the lack of musical confidence amongst teachers.

A lack of musical confidence is not the only challenge that can be faced by primary teachers when using song singing in the classroom. Some scholars have advocated that musical activities can be challenging to teach as there is a “lack of resources and time” and that there is often a “lack of priority for music” in primary school in comparison to literacy and numeracy (Russell-Bowie, 2009, p. 26/27). Conversely, other scholars have argued that with many teachers having internet access in their classrooms, there is an abundance of song singing resources available, such as on YouTube, which can be overwhelming for teachers (Pattier, 2021). Therefore, the challenge that is then faced by teachers is to find resources that are good-quality and that align with their desired learning objectives (Snelson, 2018).

Song Singing for Neurological and Memorisation Developments

Song singing can be inextricably linked to both neurological and memorisation developments in the brain (Trimble & Hesdorffer, 2017). Many scholars have advocated that music is connected to primal parts of our brain, and even from a young age, our bodies can react psychologically to musical input, such as song singing (Hudson, 2011; Thaut & Kenyon, 2003; Hasan & Thaut, 2004). Lock (2006) also found that when we practice song singing, connections among neurons in the brain can be strengthened as a result of music being processed in both cerebral hemispheres, which can lead to the stimulation of cognitive functioning and thinking. Similarly, music can allow for the enhancement of higher brain functions for abstract reasoning, and spatial-temporal conceptualisations, which are essential functions in the development of fundamental learning capabilities (Church, 2006). By allowing for active song singing experiences, a child’s brain development can be enhanced, which can promote essential thinking skills (Rauscher et al., 1997).

Another function of song singing is that it helps to make things easy to remember (Pound, 2008). When using song singing, DiDomenico (2017) ascertained that it can “improve the memorization of core subject content details and facts” (p. 13). Additionally, song singing as a pedagogical practice embodies a memorisation function by encouraging repetition, which can develop a link to the memory part of the brain (Silberg, 2005). Similarly, Dyer (2011) outlines how “students remember and retrieve information more effectively when they can link that information to music” (p. 5). This evidence illustrates the brain’s ability to work musically and exemplifies that “learning with the aid of music becomes almost effortless” (Page, 1995, p. 11).

Mathematics in Primary School

The Mathematics Curriculum in the Junior Classes

The overall aim of learning mathematics in the junior classes has been argued to be “the development of mathematical proficiency” (NRC, 2001, p. 424). Dooley et al. (2014) outline that this development of mathematical proficiency begins in the junior classes of primary school through the advancement of emergent mathematical skills and dispositions. “Emergent mathematics is a concept similar to emergent literacy” (Geist & Geist, 2008, p. 20) – it begins very early in life, it is related to other developmental milestones, and it develops from active engagement in real-life situations (Geist & Geist, 2008). Similarly, Poehlman & O’Grady (2015) refer to emergent mathematics as “the earliest phases of development of mathematical and spatial concepts” (p.1).

Emergent mathematics is reflected across the six strands of the current mathematics curriculum for the junior classes (Appendix B), especially across the EMA strand in the mathematics curriculum for junior and senior infants. The aim of the EMA strand can be identified as the need to develop counting and analysis of number at an infant level (NCCA, 1999b). The EMAs are designed to build on the mathematical knowledge and language that

children have acquired at home, and to “provide a solid foundation for subsequent mathematical investigations” (NCCA, 1999c, p. 9). The mathematical foundations that the EMAs provide can be used across the five other mathematical strands, in an attempt to maximise the child’s development of mathematical proficiency (Dooley et al., 2014).

How Children Learn Mathematics in the Junior Classes

As previously discussed, the development of mathematical proficiency is likely to begin in the junior classes of primary school, implying the necessity to develop effective pedagogies that engage children in positive mathematical experiences early on (Dooley et al., 2014). The NRC (2001) has identified that children learn mathematics most effectively when it is contextualised and when they are an active part of the learning process. Dooley (2019) would then suggest that “it is therefore not surprising that, play is given particular emphasis as a context for the promotion of mathematical thinking and learning in young learners” (p. 11). Bergen (2009) determines that play can advance and enhance logical-mathematical reasoning and metacognition, whereas Perry & Dockett (2008) see play as an opportunity for developing creativity, curiosity, problem-posing and problem-solving dispositions, which can be argued as essential functions for mathematical thinking. However, Bruce et al. (2016) determine that “play is not enough to foster the development of mathematical concepts, skills, and language” (p. 31). Instead, as Dooley et al. (2014) infer, there is also a need for emergent mathematical pedagogies to include several meta-practices, such as the promotion of math talk and the development of a productive and positive disposition towards mathematics.

However, research has shown that some mathematical instructions that are used by educational practitioners can present numerous drawbacks, most pertinently due to the lack of connections with students’ interests and needs (Furner & Berman, 2005). Mathematical instruction in the junior classes can often consist of assigning textbook tasks to the children, which can neglect children’s conceptual mathematical understandings (An et al., 2013).

Many scholars suggest that children who engage in mundane, and often negative mathematical experiences, especially in the junior classes, can sometimes go on to develop mathematics-related anxiety, low self-efficacy and confidence, and low mathematical enjoyment (Furner & Berman, 2005; An et al., 2013; 2014). This could then evolve into other undesirable mathematical learning outcomes, such as poor performance in mathematics and adverse mathematical behaviours (An et al., 2014; Ashcraft, 2002).

Therefore, it can be ascertained that teachers should be equipped with the ability to teach mathematics in various ways, in an attempt to overcome undesirable mathematical learning outcomes. One way could be to use Gardner's (1983) *Theory of Multiple Intelligences* as an alternative approach to teaching mathematics. One of Gardner's (1983) intelligences is musical intelligence, which DiDomenico (2017) and Kinney (2012) identify as an intelligence that can be integrated into the teaching of mathematics. By combining musical intelligences with mathematics, DiDomenico (2017) determines that mathematics as a subject could be enhanced and that children's attitudes towards mathematics could improve.

Integration in Primary School

The Theory of Integration

"An integrated approach to the curriculum takes advantage of the natural relationships between developmental domains and between content areas" (Koralek, 2008, p. 10). As illustrated by Bacon (2018), integration can encourage meaningful connections across subjects, which can promote more effective learning and can provide greater agency to the teacher and the learner. However, Bacon (2018) also identified that this process can be challenging as teachers need to have a "sophisticated understanding of learning and a wide pedagogical repertoire" (p. 12).

One way that integration can take place in primary school is through arts integration. "Arts integration is an approach to teaching in which students construct and demonstrate

understanding through an art form. Students engage in a creative process that connects an art form and another subject area and meets evolving objectives in both” (Humphries Mardirosian & Pelletier Lewis, 2016, p. xii). Many scholars have theorised forms of arts integration, however, Barnes (2011) summarises effective arts integration as “the promotion of creative thinking with the maintenance of disciplinary rigour and challenge” (p. 56). Nevertheless, Barnes (2011) also identifies that arts integration can be made ineffective by “trivializing, confusing, misleading, constructing new misconceptions and also failing to provide a moral context for learning” (p. 54). Therefore, teachers must have a sound and comprehensive understanding of how to integrate subjects effectively before introducing integrative teaching practices into their classrooms (Fogarty, 2009; Bacon, 2018)

The merits of integration have been frequently addressed across the literature (Barnes, 2011; Humphries Mardirosian & Pelletier Lewis, 2016; NCCA, 2018). Most notably, the NCCA (2018) report on the redesign and redevelopment of the primary curriculum indicated that there is a widespread agreement for a more integrated curriculum in the junior classes to facilitate and support learning and development. In an Irish context, Bacon (2018) determined that further integration could be an opportunity to teach around the needs and interests of students yet allowing the students to explore and deepen their own understandings of the curriculum (p. 5). Bacon (2018) also argued that integration helps to set the curriculum into the “real world”, where disciplines or subjects are not separated (p. 5). This “growing interest in integration” (Ní Chróinín et al., 2016, p. 566) is not only beneficial for learning but as Fogarty (2009) states, it is also a solution to the learning demands that are to be met within the time constraints of the primary curriculum. This could be a way to further engage children in the curriculum that they are being taught and could increase their appetite for learning.

The Integration of Song Singing in the Teaching and Learning of Mathematics in the Junior Classes: Theory and Practice

One way in which integration could take place in primary school is through the use of song singing. O'Brien (2018) highlights that "the activity of singing lends itself very naturally to cross-curricular learning", in subjects such as Geography, Art, History, Language, and Dance (p. 21/22). Smith (2002) also outlines one interesting example of how "millions of English-speaking children have learned the names of the alphabet letters more easily because someone set them to the tune of Twinkle Twinkle Little Star" (p. 646). These examples illustrate the effectiveness of song singing to support and enhance teaching and learning.

On the other hand, mathematics has been identified as a curricular subject that can be easily integrated with other subject areas, including song singing (An et al., 2014; Smith, 2002). Song singing can possess inherent mathematical concepts such as spatial properties, sequencing, counting, serial order, fractions, sorting and classifying, patterning, and one-to-one correspondence (Geist et al., 2012; Edelson & Johnson, 2003; Church, 2006). By exploring this link between song singing and mathematics, the researcher completed a review of the studies in this area to ascertain which songs would be helpful in the teaching and learning of mathematical concepts across the current mathematics curriculum for the junior classes. This work is summarised in Table 1 below.

Table 1

Examples of Some Mathematical Songs in Literature Linked to Mathematical

Strands, Strand Units, and Concepts from the current NCCA Mathematics Curriculum for the Junior Classes

Strand	Strand Unit/ Concept	Mathematical Song	Source
Number/EMA	Subtraction	Five Green and Speckled Frogs	(Anderson & Lawrence, 2013)
		Five Little Monkeys	(Church, 2006)
		Ten in a Bed	(Church, 2006; An et al., 2013)
		Five Little Seeds; Mary Up in a Spaceship	(MacGregor, 1998)
	Addition	I Caught a Fish Alive	(Church, 2006)
		Five Buzzy Bees	(MacGregor, 1998)
		One Banana	(MacGregor, 1998)
	Counting	Johnny Works with One Hammer	(McDonel, 2013)
		One Banana	(MacGregor, 1998); (Church, 2006)
		Five Wonky Bicycles; Cherries on a Plate; Ten Little Snow friends; The Mini Beast Parade; Centipede and Millipede	(MacGregor, 1998)
Algebra	Ordering	The Old Lady Who Swallowed a Fly	(Edelson & Johnson, 2003)
		Three Ducks	(MacGregor, 1998)
	Extending Patterns	If You're Happy and You Know It	(Flohr, 2006)
Measures	Time (Sequencing)	The Colour Train	(Geist et al., 2012)
		Today is Sunday	(Giles & Fresne, 2016)

	Time	Hickory digital clock; Recipes	(MacGregor, 1998)
Shape and Space	Shapes	Make a Shape; Postman	(McDonel, 2013)
		Circle; Triangle; Square; Which Shapes; Sea Shapes; Mystery Bag	(MacGregor, 1998)
	Spatial Awareness	Favourite Toys; The Hokey Cokey	(MacGregor, 1998)

This compilation of mathematical songs showcases the use of song singing across the current mathematics curriculum. Many of these songs have been specially written by the authors cited above, however, Pound (2008) and Smith (2002) have reflected on how existing songs could also be tailored to the learner's specific interests, whilst simultaneously achieving the desired mathematical learning objectives. For example, the song "*Ten in the Bed*" could be used to teach the components of the number 10, whereas MacGregor's (1998) song "*Favourite Toys*" (to the tune of "*The Wheels on the Bus*") to teach spatial awareness and relations, could be tailored to represent the toys that the children in the class like to play with e.g., "*a racing car turns left and right; a kite in the sky flies near and far; a yoyo on a string rolls up and down etc.*" (MacGregor, 1998, p. 28).

As previously discussed, song singing can also be linked to neurological and memorisation developments in the brain (Trimble & Hesdorffer, 2017; Hudson, 2011; Hasan & Thaut, 2004; Lock, 2006), and as outlined by Sawyers & Hutson-Brandhagen (2004), memorisation is perceived as a general cognitive skill for mathematics. Additionally, Pound (2008) outlined that mathematical songs can assist young learners in the complex task of memorising mathematical facts. Although the current mathematics curriculum does not promote a memorisation approach to mathematics, it can be determined that "mathematics facts have a role to play in mathematical development" and that children should be given opportunities to learn these facts in a way that promotes understanding and flexibility (PDST, n.d., p. 4). Mathematical songs can be designed to promote understanding and flexibility, and

to target specific mathematical learning objectives, whilst also assisting the learner in committing facts to memory, so that they can refer to them as a mnemonic aid whenever they are required (Werner, 2018).

These opportunities for the integration of song singing in the teaching and learning of mathematics in the junior classes can also be acknowledged as “arts-enhancing”, as song singing can provide a “hook” to focus children’s attention on mathematical concepts (Humphries Mardirosian & Pelletier Lewis, 2016). A mathematical song can help to increase engagement levels in a mathematics lesson and can bring an enjoyment factor into the learning process, and as Shilling (2002) advocated, an enjoyable song singing-mathematics lesson would not take away from the child developing logical-mathematical intelligences.

Edelson & Johnson (2003) also state that song singing can enrich the mathematical learning environment and can create an atmosphere “free of undue pressure and stress and infused with a degree of pleasurable intensity, promotes exploration and the fun of learning, and allows the child to be an active participant rather than a passive observer” (p. 65). This finding strongly aligns with the theories that state that young children really enjoy song singing (Samsundin et al., 2019) and that song singing plays a natural part in childrens’ learning experiences (Geist et al., 2012). In addition to this, a fun and engaging mathematical learning environment could also help to offset the negative attitudes that some children can have towards mathematics (Furner & Berman, 2005)

This approach to mathematical teaching and learning can be illustrated through song singing and mathematics programmes that have been implemented and analysed across international research (Gillanders & De La Fuente, 2020; An et al., 2013). Gillanders & De La Fuente (2020) implemented an intensive five-week programme in a pre-school (children aged 3-6) in Spain, and An et al. (2013) implemented a similar programme in the United States that integrated various musical activities throughout mathematics lessons. Both

intervention programmes indicated that children were more motivated to learn, eager to engage in mathematics that was integrated with musical activities, and attentive and responsive to mathematical challenges. Nevertheless, there has been no evidence of a similar song singing and mathematics programme having been implemented in Ireland to date.

Conclusion

This chapter addressed the literature that relates to song singing, mathematics, and the opportunities for integration between these two subject areas in the junior classes. The first theme focused on song singing and its importance in children's lives for enjoyment purposes and neurological and memorisation developments. Nevertheless, some primary teachers find the implementation of song singing in the classroom challenging, due to the perceived need for specialist musical knowledge or a lack of song singing confidence. The second theme reflected on mathematics and how it is currently taught, and subsequently learnt by children in primary school. The final theme centred upon integration, and the opportunities and challenges for the integration between song singing and mathematics in the junior classes were outlined. The next chapter will explore the research methodology used to investigate the integration of song singing in the teaching and learning of mathematics in the junior classes.

Chapter 3: Research Methodology

Introduction

The purpose of this chapter is to introduce the research methodology for this qualitative study. The research methodology and method for this study are discussed in-depth in this chapter, along with the sampling and interview processes, data analysis method, ethical considerations, limitations, and positionality of the researcher.

Research Methodology

A research methodology is a recipe that “allows the researcher to cook up findings to feed a research curiosity” (Egbert & Sanden, 2014, p. 75). The methodology for this study is underpinned by a constructivist perspective, whereby “meanings are varied and multiple, leading the researcher to look for the complexity of views rather than narrowing meanings into a few categories or ideas” and therefore the purpose of the research is to “rely as much as possible on the participants’ views of the situation being studied” (Creswell, 2012, p. 9).

This constructivist perspective made a qualitative methodology the most appropriate methodology to investigate the use of song singing in primary school and how it can be integrated into the teaching and learning of mathematics in the junior classes. The purpose of a qualitative methodology is “coming to understand how things work” (Stake, 2010, p. 27). A qualitative approach was appropriate for this study as it allowed for a critical insight into teachers’ experiences and perspectives on song singing to be gathered, and whether they see song singing as a beneficial integrative opportunity in the teaching and learning of mathematics in the junior classes.

A qualitative methodology can be defined as “an emergent approach to the study of people, cases, phenomena, social situations and processes in their natural settings in order to reveal the meanings that people attach to their experiences of the world” (Yilmaz, 2013, p. 312). In the context of this study, a purposive sample of Irish primary teachers was studied to

explore song singing and mathematics in the natural primary school setting.

Given the exploratory and descriptive nature of a qualitative methodology, participants were enabled to fully express their views, which allowed the researcher to gather high-quality data. As determined by Bryman (2016), a qualitative methodology enables the researcher to seek close involvement with participants, which in this case allowed the researcher to view song singing and the teaching and learning of mathematics through the participant's eyes. Additionally, this methodology allowed the researcher to probe the participants about any observations or issues that required further clarification in relation to what was being discussed (Cohen et al., 2007).

Research Method

Sampling

A research method is a specific procedure to “accomplish the task of gathering and analysing the data in the research study” (Egbert & Sanden, 2014, p. 75). In this investigation, data was gathered from five semi-structured interviews, representing four different schools, as shown in Table 2 below.

Table 2

Details of Participants

Participants (Pseudonyms)	Years of Experience in the Classroom
School 1	
Participant 1 – Finn	3
School 2	
Participant 2 – Sarah	2
Participant 3 – Katie	2
School 3	
Participant 4 – Ciara	17
School 4	
Participant 5 - Marie	35

All participants had some experience in teaching the junior classes within an Irish primary school context and all participants were familiar with the NCCA primary curriculum. There was no limitation regarding age or the number of years of teaching experience that the participant had. Henceforth, this was a purposive sample, as the researcher purposely chose participants who met these criteria. Although a representative sample would also have been appropriate to gather data for this study and would have enabled the researcher to “draw conclusions from the sample about the population as a whole” (Creswell, 2012, p. 141), the restricted timeframe for the completion of this project did not facilitate the researcher to do so.

The researcher hoped that this sample of participants would illustrate the perspectives and experiences of Irish primary teachers regarding the integration of song singing in the teaching and learning of mathematics in the junior classes. However, despite this, the researcher was aware that “everyone is different and that if the research were to be conducted with another group of people the results might not be the same” (Dawson, 2009, p. 49).

Interviews

Interviews are a beneficial and meaningful way to collect data as they “can reach the parts which other methods cannot reach” and are designed to “elicit views and perspectives” that can bring together “multiple views of people” (Wellington, 2000, p. 71). By conducting five interviews for this study, valuable insights were gathered from participants on this research topic.

There are three main types of interviews, however, for the purpose of this study, semi-structured interviews were conducted. Wellington (2000) refers to semi-structured interviews as the “most valuable” (p. 74) as the “interviewer has considerate flexibility over the range and order of questions within a loosely defined framework” (Parsons, 1984, p. 80). Semi-structured interviews were deemed most suitable for this study as they allowed the researcher

to tune into the participant's views on song singing and its use in the teaching and learning of mathematics. Although an interview schedule was prepared (Appendix F), most questions were open-ended to allow for flexibility in gaining a wide perspective from participants on song singing, mathematics, and integration. This approach allowed for variance across interviews, whilst also ensuring that the pertinent issues that needed to be addressed to complete this study were covered. However, three themes were drawn from the literature to form the basis of the interview questions: experiences and perspectives of song singing in primary school, the teaching and learning of mathematics in the junior classes, and the potential for integration between these two areas in the junior classes.

A pilot interview was conducted over *Zoom* before the official interviews took place, which was not included in the final results and data analysis. Pilot interviews provide an opportunity to pre-test the interview schedule and can eliminate “ambiguous, confusing, or insensitive questions” to enhance the reliability of the official interviews (Wellington, 2000, p. 78). After the pilot interview, some questions were amended or removed to reflect the pilot interviewee's responses and to ensure that the questions were open-ended in nature and that they facilitated the opportunity for the participant to provide deep and detailed answers.

All interviews were conducted in line with the government guidelines for the COVID-19 pandemic, which resulted in all interviews being conducted over *Zoom*. Each of the participants was made aware of how the study was to be conducted in advance of the interview taking place (Appendix D). There are benefits and drawbacks to interviews being conducted over an online video conferring platform such as *Zoom*. Cohen et al. (2007) outline how online interviews are “entirely real-time and synchronous”, and that participants can be contacted at a mutually convenient time (p. 241). However, there can be some disadvantages too, such as a “slight delay, broken images or movement in a series of freeze-frames rather

than continuous imaging”, which may interfere with the fluency of the interview (Cohen et al., 2007, p. 242).

All interviews were electronically recorded through *Zoom*’s recording platform, subject to informed consent from the participant (Appendix E). The interview recordings were transcribed verbatim and were carefully analysed to establish similarities, differences, and general themes across interviews. Field notes were also kept, during and after all interviews, for any additional observations to be recorded. Each interview lasted between 20-25 minutes.

Data Analysis

It is of paramount importance that once data is collected, that is it dealt with in “a rigorous and methodical manner” to determine meaningful and useful results (Nowell et al., 2017, p. 1). In this way, the results can then be transparently communicated to others (Malterud, 2001; Sandelowski, 1995). This research study was conducted through thematic analysis using Braun and Clarke’s (2012) six-phase approach. Thematic analysis “is a method for systematically identifying, organising, and offering insight into patterns of meaning (themes) across a data set” (Braun & Clarke, 2012, p. 57). Thematic analysis was particularly appropriate for this study as it allowed for accessibility and flexibility, whilst also providing a systematic structure for the researcher to work with when interpreting the data.

As the data was being interpreted, codes were generated to assist the researcher in comprehending the participant’s perspectives and to allow for similarities and differences to be drawn across interviews to formulate key themes. The researcher annotated the transcripts using a colour coding system to identify codes, as shown in Appendix G. The codes were generated through a combination of an inductive and deductive approach to thematic analysis (Braun & Clarke, 2012). Some codes were formed using a bottom-up approach (inductive), where they derived from the data itself, whereas other codes were formed using a top-down

approach (deductive), where the researcher used concepts and ideas that came from the literature to interpret the data (Braun & Clare, 2012). Appendix I illustrates the process of aligning themes from the literature to the final themes that emerged from the data.

Ethical Considerations

Ethical considerations pervaded the whole process of this study and were sure to respect the rights, needs, values, and desires of all participants (Cohen et al., 2007). Ethical approval was granted on the 10th of March 2021 (08-PME-1-21) by the Student Ethics in Research Committee (Appendix H). Before conducting any interviews, the BERA Ethical Guidelines and Marino Ethics Research Policy were consulted, and all research was conducted in line with these guidelines. All participants were given information about the procedures of the study, including confidentiality, consent, content, and anonymity (Appendix D). All participants were made aware that the interview would be audio recorded, and only when informed consent had been obtained did the interview process begin. Participants were also reminded of their rights before the interview commenced and had the right to withdraw from the study at any time, without any repercussions.

In line with Cohen et al. (2007), ethics can be described as “a matter of principal sensitivity to the rights of others” (p. 58). When interviewing teachers for this study, the researcher was sensitive to the teacher’s varying levels of confidence in song singing, and participants were not required to answer every question if they did not wish to do so. The interview schedule was carefully designed to ensure teachers did not feel intruded upon when asked about their teaching practices (Cohen et al., 2007; Lee, 1993). In order to ensure confidentiality and anonymity, participants were assigned pseudonyms and all data was anonymized and carefully stored on a password-protected computer. The interview transcripts were transcribed by the researcher alone from the *Zoom* recording platform, and

they were not submitted. When the data and interview transcripts were no longer required, they were destroyed and became non-traceable.

Limitations and the Positionality of the Researcher

Although inherent care was taken to ensure that this study satisfied Lincoln & Guba's (1985) criteria of credibility, transferability, dependability, and confirmability, the limitations of the study must be outlined. This research study was limited because of the sample size, as due to timing constraints, only five primary teachers were interviewed. If additional participants were interviewed, further generalisations could have been made, and it would have presented a greater insight into the teaching, learning, and integration of mathematics and song singing in primary school.

The positionality of the researcher also presented a limitation for this study. As outlined by Cohen et al. (2007), the researcher is "one who has to be accepted, become familiar and yet remain distant from those being studied" (p. 179). Given the open nature of qualitative research, the researcher's personal interests in this study could have arisen, which could have led to a bias in the findings. The researcher is an avid musician who enjoys song singing and has also studied mathematics as part of an undergraduate degree. The researcher has completed lectures on integration through an Integrated Arts Programme during the PME, and although these lectures did not discuss the integration of song singing with mathematics, the researcher was aware of the potential for cross-curricular integration.

However, despite this, it is anticipated that any bias was deterred through prudent planning and analysis. Lincoln & Guba (1985) suggest that credibility can be enhanced, and bias overcome through prolonged engagement, persistent observation, and researcher triangulation, which were at the forefront of this study. The researcher sought to be vigilant and non-judgemental and aimed to hide any known or unknown biases that could have arisen. All data was transcribed transparently, and an exhaustive review of the literature was

completed to ensure that the researcher presented truthful and unbiased data. All participants were sent a copy of their interview transcript and were enabled to verify their data if they wished to do so.

Conclusion

This chapter aimed to explore the research methodology that was used to conduct this study. The research methodology and method, data analysis process, ethical considerations, limitations, and the positionality of the researcher were discussed to outline the specifics of how the study was conducted. The next chapter will reflect on the data analysis of this study.

Chapter 4: Data Analysis

Introduction

In this chapter, the researcher provides an interpretation of some of the key findings that emerged from this study. Four key themes will be discussed that link to the literature outlined in chapter two (Appendix I). The first theme explores song singing in primary school, and how it is used by teachers outside of and across the curriculum. The following two themes discuss the benefits, and then the challenges of using song singing in the teaching and learning of mathematics in the junior classes. The final theme responds to these challenges of using song singing in the teaching and learning of mathematics in the junior classes and identifies the need for CPD courses, and further development of song singing and mathematical resources.

Song Singing in Primary School

Teachers' Use of Song Singing – Outside of the Curriculum

All participants valued the use of song singing in primary school. The participants were encouraged to discuss song singing beyond the music curriculum requirements, and, interestingly, it was determined that song singing is often used outside of the curriculum altogether. Sarah for example emphasised how she “loves singing in school whenever she can”, whereas Ciara stated that she uses “it [song singing] an awful lot because it is brilliant in the classroom and the kids just enjoy it so much”. This supports Levinowitz’s (1999) views that teachers identify song singing as a practice that can be engaged with at any time and that it should be acknowledged as an essential pedagogy in primary school. Similarly, Samsudin et al. (2019) identified that it is common for most children to love music so therefore it should be used to connect teaching and learning to children’s interests and needs.

Many teachers commented on how they would use song singing throughout the day to reinforce a desired behaviour or routine in the classroom. The participants gave examples such as a song for lining up (Sarah), the song “*Chuir mé orm mo chóta*” to collect coats (Ciara), songs to transition between lessons (Marie, Ciara), or the “*Tidy-Up*” song (Sarah). This illustrates the value of song singing in developing and reinforcing classroom practices, which can promote prosocial behaviours and self-regulation amongst children, which Kirby et al. (2022) identified as key factors in children’s engagement in the learning process.

Based on these assertions, it can be determined that most teachers and children happily engage with song singing throughout the school day, outside of the curriculum, which can lead to more positive learning experiences overall.

Teachers’ Use of Song Singing – Across the Curriculum

Following on from this, most participants also discussed the use of song singing across the curriculum. Marie shared from her experience that “you can really use song singing wherever and whenever you want in school because it can be fitted into so many different subjects”. This finding by Marie strongly aligns with the ideas of Smith (2002), Levinowitz (1999), and O’Brien (2018) who also suggested that song singing can be used to support the teaching and learning of curricular subjects. When the participants were asked to identify subjects in which they have integrated song singing, the most common subjects that were noted are as follows in the table below:

Table 3*The Integration of Song Singing Across the Curriculum*

Curricular Subject	Use of Song Singing Integration	Participants
Religious Education	First Holy Communion and other religious celebrations	Finn, Sarah Katie
Irish	Vocabulary and phrases	Ciara, Marie, Sarah, Katie
Literacy	Letter formations and grammar rules	Marie, Sarah, Katie, Ciara
Geography	Counties of Ireland	Finn
Science	Planets of the solar system	Ciara

Interestingly, no participant mentioned the integration of song singing with other arts subjects, such as Drama or Visual Arts, which have been theorised by O'Brien (2018) as curricular subjects than could easily be integrated with song singing. Nevertheless, the evidence above highlights the versatility of song singing across primary school subjects and that whether the participants were aware of it or not, children are engaging in a creative learning process through these integrated lessons (Humphries Mardirosian & Pelletier Lewis, 2016). Based on this evidence, it could be argued that song singing can fit into any curricular subject when applied and integrated accordingly.

However, some participants admitted that they only use songs in curricular subjects because they are contained within particular commercial programmes that are used by the school. For example, Sarah said, "to be honest a lot of the time I just look to see what is on the [commercial] programme and teach the children the songs from that, because they are ready to go and easy to use". The commercial programmes that were referenced by participants were *Jolly Phonics* for English literacy (Sarah, Katie), *Abair Liom* for Irish (Sarah, Katie, Finn), and *Grow in Love* for religious education (Sarah, Katie, Finn, Ciara).

Perhaps this could be a reason why none of the participants mentioned the integration of song singing across some other subjects, such as Drama or Visual Arts, as it is likely that they were not using a specific commercial programme to teach these subjects.

Interestingly, this perspective on the reliance on commercial programmes for sourcing songs was particularly voiced by the participants who have less years of teaching experience (Finn, Sarah, Katie). For example, Katie explained that “it’s good to just have the songs there for you to use because you know that they will support the learning objectives for the topic you are covering”. However, for Marie and Ciara, the participants with more years of teaching experience, they noted that commercial programmes are useful, but as Ciara said, “they are not the be-all and end-all for finding curricular songs, because oftentimes you can just pull a song from your head – you mightn’t even remember where you even learnt it, but it will do the job”. This would suggest that the more experience that teachers have, the less they have to rely on commercial programmes for songs, as they can use songs that they have picked up over time, as Marie and Ciara both suggested.

Nevertheless, for teachers with less teaching experience or a lack of song singing knowledge, a commercial programme can be useful to bring song singing into different curricular subjects and can present opportunities for creative learning processes.

The Benefits of Using Song Singing in the Teaching and Learning of Mathematics in the Junior Classes

All participants in this study could suggest some benefits associated with using song singing in the teaching and learning of mathematics in the junior classes. As Marie put it, “it [song singing] is a huge, huge benefit for teaching and learning in all areas and it definitely works in mathematics”. Although Marie had often thought about the integration between song singing and mathematics, other participants such as Finn said he “never really thought too much about it” and he said that “it [song singing] is something I would use without

thinking too much about”. The benefits discussed by the participants have been grouped into three areas. The first area looks at how song singing can contribute to the memorisation and solidification of mathematical principles, concepts, and facts. The second area relates to the use of song singing to make mathematics lessons more engaging and enjoyable, and the final area looks at how song singing can make mathematical content more relatable to children’s lives.

Song Singing for the Memorisation and Solidification of Mathematical Principles, Facts, and Concepts

Many participants identified a link between song singing and the memorisation and solidification of mathematical principles, facts, and concepts. As Marie said, “when something [mathematics] is put to music, song, or rhyme it makes it so much easier to remember, especially if it is catchy”. Marie continued with an anecdote about a second class that she once taught, identifying how “it didn’t matter how many times I said it [the rule for regrouping tens and units], or how many posters I had up, it was putting it to a song in the end that made the difference”. This anecdote from Marie strongly reiterates the research done by Silberg (2005) and Dyer (2011), that outlines the value of song singing to remember and retrieve information stored in the brain. In line with Silberg (2005), when mathematical content is sung, it can strengthen the link to the memory part of the brain, helping the child to remember the content for longer.

Similarly, Sarah stated that “it [song singing] can make things [concepts] stick for longer and it really solidifies those core mathematical skills”. This suggests song singing as a useful pedagogy in helping children to recall information and to be able to locate the knowledge in their brains over time. Ciara illustrated this through an anecdote about a pupil who was taught an eight times table song early in the school year, and during the standardised testing at the end of the year that the child was caught singing the song as he completed his

test. This anecdote illustrates how song singing can help young learners to solidify mathematical facts and recall them over time, which strongly aligns with DiDomenico's (2017) work on the *Effective Integration of Music in the Elementary School Classroom*.

Song Singing for Mathematical Engagement and Enjoyment

A common response from participants when asked to identify the benefits of song singing and its use in the teaching and learning of mathematics in the junior classes was that it can increase engagement and enjoyment in lessons. For example, Ciara said that:

When we are singing in the classroom, it's often the case that we accompany the song with actions that get us up and out of our seats, which is just so excitable for kids, and although they think it is all a bit of fun, they are actually really learning and internalising a particular mathematical rule or fact through song.

Ciara's views identified that the purpose of song singing is not always directly linked to the mathematical learning objectives, and instead can be used as a tool to get the children's attention and to make them interested in the learning. For example, Ciara also mentioned that she would often teach mathematics after a literacy lesson and said that:

Song singing can be very useful as a transition or a kind of movement break into the introduction of the [mathematics] lesson and to recap whatever was going to be coming up that day, or particular ones [mathematics principles, concepts, or facts], the children find challenging.

Similarly, Sarah and Finn identified that a song can help the children to refocus and can get them back on task, which is a similar view to Humphries Mardirosian & Pelletier Lewis (2016), who identified song singing as a "hook" at the beginning of a lesson. This would suggest that when children are exposed to song singing that they become more engaged and intrinsically motivated to learn (An et al., 2013).

However, other participants identified that the increase in engagement and enjoyment that is associated with song singing can also be a way to reinforce or practice mathematical content. Not only are the lessons more exciting and interactive (Ciara, Katie), which Shilling (2002) advocates as a key factor in mathematics lessons, but the children are also developing logical-mathematical intelligences that are associated with the song. Marie summarised Shilling's (2002) views and the views shared by some of the other participants by stating that "song singing reduces the challenge and can take the chore away from learning". She continued by saying that "integrating song singing with mathematics can be a far more fun way of practicing something and that it [song singing] would definitely help to get the message [mathematics] across".

Therefore, the insights from some of the participants and authors in the literature would indicate that song singing for engagement and enjoyment has two primary purposes. The first purpose aligns with the mathematical learning objectives and the second interests and prepares the children for the learning that is to come.

Song Singing for Mathematical Relatedness and Connectedness to Children's Lives

Some participants also noted that song singing can help to make content more relatable for the learner. Furner & Berman (2005) theorised that some mathematical instructions, such as the use of textbook tasks, can often make mathematics difficult for children to relate to. Nevertheless, the findings from this study suggest song singing as a possible way to overcome this challenge of unrelatable mathematical instructions. Oftentimes, mathematical concepts can lack connections with students' interests and needs, however as some participants noted that song singing can be a way to make content more approachable and interesting for learners (Ciara, Marie, Katie). As Ciara said, "by using mathematical songs, children are forming connections and making sense of the content in a practical way". Sarah also commented on how the use of song singing can be used to

“associate what they are doing with sound without even realising”, which illustrates an immense benefit of integration, as Bacon (2018) similarly outlined.

It also became evident from the data that song singing integrated into mathematics lessons can impact children’s learning in different ways, depending on the child’s mathematical abilities. For some children who don’t struggle with mathematics, Ciara said that a song is just an “added extra” for them, whereas for a struggling mathematics learner, Finn said that a mathematical song could “suddenly just make it click for them”. These views shared by the participants reflect the needs of the individual learners in each class and acknowledge how song singing can relate to individuals in different ways.

Interestingly, the findings presented in the data also indicated that song singing could be used across all class levels of primary school to make mathematics more meaningful and relatable for all children. Some participants (Marie, Ciara, Finn) identified that song singing “should not just be focused on the junior classes” (Ciara), as it could also help older children to make sense of and remember mathematical principles, concepts, or facts in a fun and engaging way. This evidence outlines the transferability of integration across all primary school class levels, as also theorised by Bacon (2018).

The Challenges of Using Song Singing in the Teaching and Learning of Mathematics in the Junior Classes

When the researcher asked the participants about the challenges of using song singing, many participants’ initial responses were that they struggled to identify any challenges and that instead song singing “could be seen as a tool to take challenges away for children” (Ciara). However, upon further discussion and reflection, the researcher uncovered some challenges which have been grouped into three areas. The first area addresses teachers’ experiences in the classroom. The second area looks at the availability of mathematical and

song singing resources, and the final area reflects on the use of mathematics textbooks which can impede inclusive and integrated mathematical learning experiences.

Teachers' Experiences in the Classroom

The participants represented teachers with a range of teaching experiences, and each participant had different experiences of song singing. The data was conflicted in this area, as for the more experienced teachers (Marie, Ciara), their song singing confidence “is never an issue” as Ciara put it. On the other hand, some of the less experienced teachers (Finn, Katie) said that they would be “more reserved about singing” and that they would “often sing along to a CD or backing track because [they] wouldn’t be confident to sing by [themselves]” as Finn said. Teachers’ lack of confidence in song singing has often been cited in the literature (Richards, 1999; Hennessy, 2000), and can result in the children being less interested in engaging in song singing.

From this, it can be ascertained that the effectiveness of song singing in primary school comes down to the class teacher. As Ciara said, “it is all about how the teacher sells it”, and that “the more invested and involved the teacher is in these things [song singing], the greater the success will be”. Both the data and the literature allude to the importance of teachers valuing song singing and being confident in their song singing abilities. Perhaps, for some, this confidence only comes with more classroom experience, however, others may benefit from additional support and resources to increase their song singing confidence.

The Availability of Song Singing and Mathematical Resources

A common view that was considered by most participants was that they don’t think that good-quality resources that promote the integration between song singing, and mathematics are easily and readily available. The participants with less teaching experience in particular (Finn, Katie, Sarah) asserted that although they see the value in mathematical

song singing, they don't have the knowledge of where to find good-quality resources and don't know how to learn more about this integrative opportunity. Katie said that she would sometimes "throw a maths topic into YouTube just to see what comes up", but she disclosed that this does not always result in good-quality songs and is often "just an extra effort which I don't have time for" and that "you would question whether it was really worth the effort in the end". This evidence reflects a similar perspective to the challenges of using song singing in the classroom that was outlined by Russell-Bowie (2009), stating that primary teachers often determine that there is a lack of readily available and good-quality resources for music.

All participants were able to give some examples of mathematical songs that they use or are familiar with such as "*The Days of the Week Song*" or "*The Months of The Year Song*" for sequencing (Katie, Sarah), counting songs to solidify number facts, times tables or skip counting (Ciara, Marie), rhymes to recall a number formation (Sarah) or mathematical procedure (Marie). However, considering the mathematics curriculum more broadly, the participants articulated that they would "definitely not" (Finn) and "would find it very hard" (Katie) to be able to identify songs for all strands of the mathematics curriculum. This would suggest an appetite for an explicit breakdown of the mathematics curriculum that is linked to songs to ensure learning objectives are being met, similar to the table that was designed by the researcher in chapter two (Table 1). The researcher designed this compilation of songs by aligning the current mathematics curriculum for the junior classes with mathematical songs that were previously outlined across the literature, such as MacGregor's (1998) *Tom Thumb's Musical Maths* or McDonel's (2013) exploration into the relationship between music and mathematics learning. Although this compilation of songs was primarily formulated on the researcher's interpretation of the literature and understanding of the curriculum, a similar resource could serve as a possible solution to addressing the challenges of integrating song singing and mathematics.

The “Textbook Teaching” of Mathematics

Some participants had concerns over the pressure that is put on teachers to ensure that textbooks are completed, which can impede inclusive, integrated, and active mathematical learning experiences in the junior classes. Katie and Sarah in particular stated that oftentimes opportunities for integrated learning can be inhibited because as Katie said, “there is always the pressure of having to get pages in the book done”. Katie and Sarah instigated that this “textbook teaching”, as Sarah stated, reflects a lack of connections with students’ interests, and can lead to mathematics-related anxiety, low self-efficacy and confidence, and low mathematical enjoyment (Furner & Berman, 2005; An et al., 2013). It has been identified by Silberg (2005) and Bergen (2009), that although textbook tasks are important to reinforce and practice mathematical skills, they should not take away from the opportunity for integrated and inclusive mathematics lessons. This throws up considerable challenges for policymakers in balancing the use of the mathematics textbook with the opportunity to facilitate inclusive and integrated mathematics lessons without the “constant pressure to complete pages from the book”, as Katie and Sarah discussed.

Responding to the Challenges of Using Song Singing in the Teaching and Learning of Mathematics in the Junior Classes

Throughout the discussions of the challenges in this area, the participants explored the possible responses and solutions for the integration of song singing with mathematics to be promoted, including the development of CPD courses and song singing and mathematical resources. All participants were hugely interested in learning more about this integrative opportunity and reported a desire to increase their knowledge in this area so that they could use it in their classes.

Continuous Professional Development (CPD) Courses

All participants reported a desire for CPD courses to be made available on the integration between mathematics and song singing. This indicates the participants' willingness to explore the topic in greater depth, as they clearly appreciate the value song singing can bring to the teaching and learning of mathematics. Ciara suggested that the use of song singing could be taught as a module within mathematics CPD training courses, and Katie also said that she thought "it [a song singing and mathematics CPD course] would actually be really interesting and that lots of teachers would enjoy it". These claims that were made by Ciara and Katie were also affirmed in the literature by DiDomenico (2017). Similarly, Hennessy (2017) also advised that CPD training would help with teachers' confidence in song singing, which Finn and Katie noted their lack thereof in their interview.

The Development of Song Singing and Mathematical Resources

In addition to CPD courses, most participants also articulated the need for song singing and mathematical resources to be readily available and of a good-quality. Marie in particular reckoned that teachers would make use of this integrative opportunity more often if good-quality resources were available without any additional effort. It was no surprise, that none of the participants were aware of "a one-stop shop for song singing and maths", as Ciara said, for identifying songs that align with the curriculum objectives. However, many of the participants identified the need for such a resource.

Another view that was shared by Katie and Sarah was that if the commercial mathematics programme used in schools such as *Busy at Maths* or *Mathemagic* had songs integrated throughout it, that they would definitely use them and that it would make the textbook teaching more exciting and engaging for the children.

Conclusion

This chapter has analysed the data that emerged from this study. Firstly, the researcher uncovered the participants' views on song singing in primary school and discovered the areas in which teachers were found to have used song singing outside of and across the curriculum. The researcher then focused on song singing and mathematics and identified the main benefits and challenges of this integrative opportunity. Finally, the researcher responded to the challenges that came from the data, by addressing the participants' desire for CPD courses and the development of resources in the area of song singing and mathematics in primary school. The next chapter will discuss the final conclusions of this research project and will provide some recommendations and areas for further research.

Chapter 5: Conclusions and Recommendations

Introduction

This research project sought to investigate the integration of song singing in the teaching and learning of mathematics from junior infants to second class. The researcher hoped to do this by providing critical insights into the perspectives and experiences of Irish primary teachers on using song singing in primary school and how song singing can be used in the teaching and learning of mathematics in the junior classes. Given that the current mathematics curriculum is under reform, this study was carried out to assess the value of integrating song singing across the new mathematics curriculum. The researcher conducted a comprehensive review of the literature and uncovered the main themes that have been published on this topic. These themes informed and guided the collection of data from a purposive sample of Irish primary teachers, who shared their insights into the uses of song singing in primary school, and the benefits and challenges of integrating song singing and mathematics in the junior classes. It was also noted by participants that CPD courses and the development of further song singing, and mathematical resources could assist with their use of this integrative opportunity in the classroom. It is hoped that the findings and recommendations from this study will contribute positively to the expanding areas of research relating to mathematics in primary school and how it can be integrated with song singing.

Recommendations for Educational Practice and Policy

Upon reflection of the literature in this field and the data that was collected during this study, the researcher recommends some areas of development for educational practice and policy. Firstly, as previously discussed, the development of CPD courses on the integration of song singing and mathematics would support teachers in understanding and implementing this valuable integrative opportunity in their classrooms. These courses could outline the

importance of song singing and could provide teachers with advice on using song singing as part of their teaching practices. In addition to this, it would be recommended that resources are developed to make mathematical songs easily and readily available. A wider project investigating the possible linkage between song singing and mathematics could help to overcome this challenge of sourcing good-quality mathematical songs.

The researcher would also recommend that the NCCA considers the benefits of integration in the development of the new mathematics curriculum, especially the opportunity for song singing in the junior classes. The latest draft of this curriculum acknowledges the need for learning to be integrated across contexts, however, there is no mention of the use of song singing or music to do this.

Areas for Further Research

Given the limitations of this study, due to timing constraints, the researcher has identified that further investigations into song singing, and mathematics could be done with a larger sample of participants. A larger-scale study would provide greater insights into the perspectives and experiences of primary teachers in using song singing for the teaching and learning of mathematics, across all class levels. Additionally, the researcher identifies the value that research beyond Ireland would provide in the area of song singing and mathematics. By investigating the use of song singing for the teaching and learning of mathematics in other countries, comparisons could be made from country to country and a wealth of resources could be accumulated.

There is also an opportunity for further research to be done in the development of an integrated mathematics programme or resources that would provide teachers with readily available content that aligns with the learning objectives of the mathematics curriculum. This study has shown an appetite for the development of such resources.

The final area for further research that is being suggested is an investigation into the use of other musical concepts or elements that could be used in the teaching and learning of mathematics in primary school. Due to the limited timeframe and the researcher's personal experiences, this study only investigated the use of song singing in the teaching and learning of mathematics, however, further research could be done on areas such as rhythm, beat, composition, or the use of musical instruments for mathematics.

Final Conclusion

At a time when what is taught and how is it taught in primary schools is being reformed, a focus on how music can be integrated into teaching and learning is timely. Song singing is a natural part of children's lives, and it is our role as educators to use it as an opportunity to help promote better mathematical success and enjoyable learning experiences in our classrooms. As MacGregor (1998) put it "music and maths, maths and music, add them together as quick as a wink, musical maths, mathematical music, the sum of these two is more than you'd think".

References

- An, S., Capraro, M. M., & Tillman, D. A. (2013). Elementary Teachers Integrate Music Activities into Regular Mathematics Lessons: Effects on Students' Mathematical Abilities. *Journal for Learning through the Arts*, 9(1), 1-19. <https://escholarship.org/uc/item/0js732gf>
- An, S., Boren, R., Tillman, D. A., & Wang, J. (2014). Fostering Elementary Students' Mathematics Disposition through Music-Mathematics Integrated Lessons. *International Journal for mathematics teaching and learning*, 15, 1-19. <http://www.cimt.org.uk/journal/an.pdf>
- Anderson, W. M., & Lawrence, J. E. (2013). *Integrating Music into the Elementary Classroom*. Cengage Learning.
- Ashcraft, M. H. (2002). Math anxiety: Personal, educational, and cognitive consequences. *Current Directions in Psychological Science*, 11(5), 181-185. <https://doi.org/10.1111/1467-8721.00196>
- Bacon, K. (2018). *Curriculum Integration*. Marino Institute of Education/NCCA. https://ncca.ie/media/3499/seminar-two_bacon-paper.pdf
- Barbour, R. S., & Schostak, J. (2005). Interviewing and Focus Groups. In, Somekh, B, & Lewin, C. (Eds.) *Research Methods in the Social Sciences* (pp. 41-48). Sage. https://www.researchgate.net/publication/41199558_Interviewing_and_focus_groups
- Barnes, J. (2011). *Cross Curricular Learning 3-14*. SAGE Publications

Bergen, D. (2009). Play as the learning medium for future scientists, mathematicians, and engineers.

American Journal of Play, 1(4), 413-428.

<https://www.journalofplay.org/sites/www.journalofplay.org/files/pdf-articles/1-4-article-play-as-learning-medium.pdf>

Braun, V., & Clarke, V. (2012). Thematic analysis. In, Cooper, H., Camic, P. M., Long, D. L.,

Panter, A. T., Rindskopf, D., & Sher, K. J. (Eds.) *APA handbook of research methods in psychology*, 2, (pp. 57-71). American Psychological Association.

Bruce, C., Flynn, T., & Moss, T. (2016). Early mathematics: Challenges, possibilities, and new directions in the research. *Mathematics for Young Children (M4YC) Literature Review*.

http://mkn-rcm.ca/wp-content/uploads/2016/11/M4YC_LiteratureReview_25June12_RevisedSept2016.pdf

Bryman, A. (2016). *Social Research Methods*. Oxford University Press.

Church, E. B. (2006). Math & Music: The Magical Connection. *Scholastic Parent & Child*, 8(3), 50-55.

<https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=eue&AN=4159081&site=eds-live>

Cohen, L., Manion, L., & Morrison, K. (2007). *Research Methods in Education* (6th ed.). Routledge.

Creative Ireland. (2021). *Creative Ireland Programme 2017-2022*. Creative Ireland.

<https://www.creativeireland.gov.ie/app/uploads/2019/12/Creative-Ireland-Programme.pdf>

Creswell, J. W. (2012). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (2nd ed.). Sage Publications.

Dawson, C. (2009). *Introduction to Research Methods: A practical guide for anyone*. Little, Brown Book Group.

- Department of Education and Skills (DES). (2012). *Arts in Education Charter*. Department of Arts, Heritage, and the Gaeltacht. <https://artsineducation.ie/wp-content/uploads/Arts-In-Education-Charter1.pdf>
- DiDomenico, J. (2017). Effective Integration of Music in the Elementary School Classroom. *Inquiry in Education*, 9(2), 1-17. <https://digitalcommons.nl.edu/ie/vol9/iss2/4>
- Dooley, T., Dunphy, E., & Shiel, G. (2014). *Mathematics in Early Childhood and Primary Education (3-8 years)* (Report No. 18). NCCA. https://ncca.ie/media/2147/ncca_research_report_18.pdf
- Dooley, T. (2019). *Learning and Teaching Primary Mathematics: An addendum to NCCA research report 17 and 18*. DCU Institute of Education. https://ncca.ie/media/4087/primary_maths_research_addendum_2019.pdf
- Dunphy, E. (2000). Early childhood mathematics teaching: challenges, difficulties, and priorities of teachers of young children in primary schools in Ireland. *International Journal of Early Years Education*, 17 (1), 3-13. <http://dx.doi.org/10.1080/09669760802699829>
- Dyer, J. L. (2011). Musical thought: Using music to enhance literacy instruction. *Illinois Reading Council Journal*, 39(4), 3-9. <https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=eue&AN=67074143&site=eds-live>
- Edelson, J., & Johnson, G. (2003). Music Makes Math Meaningful. *Childhood Education*, 80(2), 65-70. <https://doi.org/10.1080/00094056.2004.10521259>
- Egbert, J., & Sanden, S. (2014). *Foundations of Education Research: Understanding Theoretical Components*. (2nd ed.). Routledge.

- Fauvel, J., Flood, R., & Wilson, R. J. (Eds.). (2006). *Music and Mathematics: From Pythagoras to Fractals*. Oxford.
- Flohr, J. W. (2006). Enriching Music and Language Arts Experiences. *General Music Today*, 19(2).
<https://doi.org/10.1177/10483713060190020104>
- Fogarty, R. (2009). *How to Integrate the Curricula*. Corwin.
- Furner, J., & Berman, B. (2005). Confidence in their ability to do mathematics: The need to eradicate math anxiety so our future students can successfully compete in a high tech globally competitive world. *Dimensions in Mathematics*, 18(1), 28-31.
http://socialsciences.exeter.ac.uk/education/research/centres/stem/publications/pmej/pome18/furner_math_anxiety_2.htm
- Gardner, H. (1983). *Frames of mind: The theory of multiple intelligences*. Basic Books.
- Geist, K., & Geist, E. A. (2008). Do Re Mi, 1-2-3 That's How Easy Math Can Be: Using Music to Support Emergent Mathematics. *Young Children*, 63(2), 20-25.
<https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=edsjsr&AN=edsjsr.42730965&site=eds-live>
- Geist, K., Geist E. A., & Kuznik, K. (2012). The Patterns of Music: Young Children Learning Mathematics through Beat, Rhythm, and Melody. *Young Children*, 67(1), 74-79.
https://elf2.library.ca.gov/training/docs/PatternsMusic_Geist.pdf
- Giles, R. M., & Fresne, J. (2016). Connecting Music, Movement, and Mathematics. *Perspectives*, 11(1/2), 22-26. <file:///C:/Users/cloda/Downloads/Perspectives2016-ConnectingMusicMovementandMathematics-1.pdf>

- Gillanders, C., & De La Fuente L. C. (2020). Enhancing mathematical thinking in early childhood through music. *Pedagogies: An International Journal*, 15(1), 60-79.
<https://doi.org/10.1080/1554480X.2019.1673167>
- Güven, Y., & Gök Çolak, F. (2019). Difficulties of Early Childhood Education Teachers in Mathematics Activities. *Acta Didactica Napocensia*, 12(1), 89-106.
[file:///C:/Users/cloda/Downloads/EJ1222940%20\(1\).pdf](file:///C:/Users/cloda/Downloads/EJ1222940%20(1).pdf)
- Hasan, M. A., & Thaut, M. H. (2004). Statistical Analysis for Finger Tapping with a Periodic External Stimulus. *Perceptual & Motor Skills*, 99(2), 643–61.
<https://doi.org/10.2466/pms.99.2.643-661>
- Hennessy, S. (2000). Overcoming the red feeling: the development of confidence to teach music in primary school amongst student teachers. *British Journal of Music Education*, 17(2), 183-196. <https://doi.org/10.1017/S0265051700000243>
- Hennessy, S. (2017). Approaches to increasing the competence and confidence of student teachers to teach music in primary school. *Education 3-13*, 45(6), 689-700.
<https://doi.org/10.1080/03004279.2017.1347130>
- Hudson, N. J. (2011). Musical beauty and information compression: Complex to the ear but simple to the mind? *BMC Research Notes*, 4(9), 1-9. <https://doi.org/10.1186/1756-0500-4-9>
- Humphries Mardirosian, G., & Pelletier Lewis, Y. (Eds.). (2016). *Arts Integration in Education: Teachers and Teaching Artists as Agents of Change (Theatre in Education)*. Intellect Ltd.
- Kerin, M. (2019). *Coaching Music in a Primary School: Teacher Perspectives*. [Unpublished Doctor of Philosophy thesis]. Trinity College Dublin.
- Kinney, A. (2012). Loops, lyrics, and literacy: Song writing as a site of resilience for an urban adolescent. *Journal of Adolescent & Adult Literacy*, 55(5), 395-404.

https://www.researchgate.net/publication/264685998_Loops_Lyrics_and_Literacy_Songwriting_as_a_Site_of_Resilience_for_an_Urban_Adolescent

Kirby A. L., Dahbi, M., Surrain, S., Rowe, M. L., & Luk, G. (2022). Music Uses in Preschool Classrooms in the U.S.: A Multiple-Methods Study. *Early Childhood Education Journal*.
<https://doi.org/10.1007/s10643-022-01309-2>

Koralak, D. (2008). Integrating the Curriculum in the Early Years and Beyond. *Young Children*, 63 (2), 10-11. <https://www.jstor.org/stable/i40102790>

Lee, R. M. (1993). *Doing Research on Sensitive Topics*. Sage.

Levinowitz, L. M. (1999). The Importance of Music in Early Childhood. *Music Educators Journal*, 86(1), 17-18. <https://eric.ed.gov/?id=EJ624041>

Lincoln, Y., & Guba, E. G. (1985). *Naturalistic Inquiry*. Sage.

Lock, R. (2006). Use music in the classroom. *Intervention in School & Clinic*, 41(5), 307- 309.
<https://doi.org/10.1177%2F10534512060410050901>

MacGregor, H. (1998). *Tom Thumb's Musical Math*. HarperCollins Publishers.

Malterud, K. (2001). Qualitative research: Standards, challenges, and guidelines. *The Lancet*, 358, 483–488. <https://www.sciencedirect.com/science/article/abs/pii/S0140673601056276>

McDonel, J. S. (2013). Exploring the relationship between music learning and mathematics learning in an interdisciplinary pre-k curriculum. *Music and mathematics: early learning connections*. ProQuest. <https://www.proquest.com/docview/1459751304>

National Research Council (NRC). (2001). *Adding it up: Helping children to learn mathematics*. The National Academies Press.

<https://static1.squarespace.com/static/5b4fde59b27e395aa0453296/t/5bd2a5d89140b763780f0aab/1540531701125/Kilpatrick%2C+Swafford%2C+Findell+-+2001+-+Adding+It+Up+Helping+Children+Learn+Mathematics+copy.pdf>

- Ní Chróinín, D., Ní Mhurchú, S., & Ó Ceallaigh, T. J. (2016). Off-balance: the integration of physical education content learning and Irish language learning in English-medium primary schools in Ireland. *Education 3-13: International Journal of Primary, Elementary, and Early Years Education*, 44(5), 566-576.
<https://www.tandfonline.com/doi/pdf/10.1080/03004279.2016.1170404?needAccess=true>
- Nowell, L., Norris, J. M., White, D. E., & Moules, N. J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, 16, 1-13.
<https://doi.org/10.1177/1609406917733847>
- O'Brien, M. A. (2018). *Operation Singing Nation: a case study towards fulfilling the professional development needs of teachers in Ireland to facilitate group singing* [Unpublished Master in Music Performance thesis]. Royal Irish Academy of Music.
- Page, N. (1995). *Music as a Way of Knowing*. Stenhouse Publishers.
- Palmer, A. (2010). 'Let's Dance!' Theorising Alternative Mathematical Practices in Early Childhood Teacher Education. *Contemporary Issues in Early Childhood*, 11(2). 130-143.
<https://doi.org/10.2304/ciec.2010.11.2.130>
- Parsons, D. (1984). *Employment and Manpower Surveys: A Practitioner's Guide*. Ashgate Publishing Limited.
- Pattier, D. (2021). Teachers and YouTube: The use of video as an educational resource. *Ricerche Di Pedagogia e Didattica*, 16(1), 59–77. <https://doi.org/10.6092/issn.1970-2221/11584>
- Perry, B., & Dockett, S. (2008). Young children's access to powerful mathematical ideas. In English, L. D. (Eds.) *Handbook of international research in mathematics education (2nd ed.)* (pp. 75-108). Routledge.
- Poehlman, S., & O'Grady, M. (2015). ELM – Emergent Literacy and Math Toolkit. *Save the Children*. https://resourcecentre.savethechildren.net/node/10017/pdf/elm_brief_final.pdf

Pound, L. (2008). *Thinking and Learning about Mathematics in the Early Years*. Routledge/Nursery World.

Professional Development Service for Teachers (PDST). (n. d.). *Developing Number Sense in Irish Primary School Classrooms*. PDST.

<https://pdst.ie/sites/default/files/Developing%20Number%20Sense%20in%20Irish%20Primary%20Schools%20%281%29.pdf>

Rauscher, F. H., Shaw, G. L., Levine, L. J., Wright, E. L., Dennis, W.R., & Newcomb, R. L. (1997). Music training causes long-term enhancement of preschool children's spatial-temporal reasoning. *Neurological Research*, 19(1), 1–8.

<https://doi.org/10.1080/01616412.1997.11740765>

Richards, C. (1999). Early childhood preservice teachers' confidence in singing. *Journal of Music Teacher Education*, 9, 6-17. <https://doi.org/10.1177%2F105708379900900103>

Russell-Bowie, D. (2009). What me? Teach music to my primary class? Challenges to teaching music in primary schools in five countries. *Music Education Research*, 11(1), 23-36.

<https://doi.org/10.1080/14613800802699549>

Samsudin, M. A., Kamariah, A. B., & Noorhayati, M. N. (2019). The Benefits of Music and Movement in Early Mathematics. *Creative Education*, 10(12), 3071-3081.

<https://doi.org/10.4236/ce.2019.1012231>

Sandelowski, M. (1995). Qualitative analysis: What it is and how to begin. *Research in Nursing and Health*, 18, 371–375. <https://doi.org/10.1002/nur.4770180411>

Sawyers, K., & Hutson-Brandhagen, J. (2004). Music and Math: How Do We Make the Connection for Pre-schoolers? *Child Care Exchange*, 46-49.

<https://www.childcareexchange.com/library/5015846.pdf>

- Shilling, W. A. (2002). Mathematics, Music, and Movement: Exploring Concepts and Connections. *Early Childhood Education Journal*, 29(3), 179-184.
<https://link.springer.com/article/10.1023/A:1014536625850>
- Silberg, J. (2005). Singing Songs for Learning. *Early Childhood News*, 17(6), 22-23.
<https://search.ebscohost.com/login.aspx?direct=true&AuthType=ip,shib&db=eue&AN=19248480&site=eds-live>
- Smith, J. A. (2002). Singing and song writing support early literacy instruction. *The Reading Teacher*, 53(8), 646-649. <https://eric.ed.gov/?id=EJ604786>
- Snelson, C. (2018). The Benefits and Challenges of YouTube as an Educational Resource. In Hobbs, R (Eds.), *The Routledge Companion to Media Education, Copyright, and Fair Use*. Routledge.
- Stadler Elmer, S. (2011). Structural aspects of early song singing. In Baldassare, A. (Eds.), *Music – Space – Chord – Image. Festschrift for Dorothea Baumann's 65th birthday* (pp. 765-782). Lang.
- Stake, R. E. (2010). *Qualitative research: Studying how things work*. Guilford Press.
- Thaut, M.H., & Kenyon, G.P. (2003). Rapid Motor Adaptations to Subliminal Frequency Shifts during Syncopated Rhythmic Sensorimotor Synchronization. *Human Movement Science*, 22(3), 321–38. [https://doi.org/10.1016/s0167-9457\(03\)00048-4](https://doi.org/10.1016/s0167-9457(03)00048-4)
- The Irish Times, (1998, November 3). Sing a song of sixpence...*The Irish Times*.
<https://www.irishtimes.com/news/education/sing-a-song-of-sixpence-1.210390>
- The National Council for Curriculum and Assessment (NCCA). (1999a). *Primary School Curriculum: Music*. The Stationary Office.
https://www.curriculumonline.ie/getmedia/6d3a3e34-69ed-464e-9d3e-002ab7e47140/PSEC04c_Music_Curriculum.pdf

The National Council for Curriculum and Assessment (NCCA). (1999b). *Primary School*

Curriculum: Mathematics. The Stationary Office.

https://www.curriculumonline.ie/getmedia/9df5f3c5-257b-471e-8d0f-f2cf059af941/PSEC02_Mathematics_Curriculum.pdf

The National Council for Curriculum and Assessment (NCCA). (1999c). *Teacher Guidelines:*

Mathematics. The Stationary Office. https://www.curriculumonline.ie/getmedia/f4374e02-b6bd-4028-8e46-b2ba158c44e6/PSEC02-Maths_Guidelines.pdf

The National Council for Curriculum and Assessment (NCCA). (2010). *Curriculum Overload in*

Primary Schools: An overview of national and international experiences. NCCA.

https://ncca.ie/media/2052/curriculum_overload_in_primary_schools_an_overview_of_national_and_international_experiences.pdf

The National Council for Curriculum and Assessment (NCCA). (2018). *Primary Developments:*

Consultation on Curriculum Structure and Time: Executive summary of final report. NCCA.

https://ncca.ie/media/3245/primary-developments_consultation-on-curriculum-and-time_executive-summary-of-final-report.pdf

The National Council for Curriculum and Assessment (NCCA). (2019). *Primary Curriculum Review*

and Redevelopment: Information for Schools. NCCA. <https://ncca.ie/media/3963/pbm-english-final.pdf>

The National Council for Curriculum and Assessment (NCCA). (2022). *Primary Mathematics*

Curriculum: Draft Specification for Consultation. NCCA.

https://ncca.ie/media/5370/draft_primary_mathematics_curriculum_specification.pdf

Trimble, M., & Hesdorffer, D. (2017). Music and the brain: the neuroscience of music and musical appreciation. *BJPsych International*, 14(2), 28-31.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5618809/>

- Turner, M. E. (1999). Child-Centered Learning and Music Programs: Child-Centered Learning in Music Programs for Young Children Can Foster Their Emotional, Social, Cognitive, and Musical Development. *Music Educators Journal*, 86, 30-51. <https://doi.org/10.2307/3399574>
- Wellington, J. (2000). *Educational Research: Contemporary Issues and Practical Approaches*. Continuum International Publishing Group Ltd.
- Werner, R. (2018). Music, movement, and memory: Pedagogical songs as mnemonic aids. *TESOL Journal*, 9 (4), 1-11. <https://doi.org/10.1002/tesj.387>
- Yilmaz, K. (2013). Comparison of quantitative and qualitative research traditions: Epistemological, theoretical, and methodological differences. *European Journal of Education*, 48(2), 311-325. <https://doi.org/10.1111/ejed.12014>

Appendices

Appendix A: NCCA Music Curriculum

NCCA Music Curriculum (Strands & Strand Units) - Junior Infants to Second Class

Strands	Infant Classes and First- and Second-Class Strand Units
Listening and Responding	Exploring sounds; Listening, and responding to music
Performing	Song singing; Early literacy; Playing instruments
Composing	Improvising and creating; Talking about and recording compositions

(NCCA, 1999a, p. 15/27)

Appendix B: NCCA Mathematics Curriculum

NCCA Mathematics Curriculum (Strands & Strand Units) – Junior Infants to Second Class

Strands	Infant Classes Strand Units	First and Second Class Strand Units
Early Mathematical Activities	Classifying; Matching; Comparing; Ordering	
Number	Counting; Comparing, and ordering; Analysis of number (combining, partitioning, numeration)	Counting and numeration; Comparing and ordering; Place value; Operations (addition, subtraction), fractions
Algebra	Extending patterns	Exploring and using patterns
Shape and Space	Spatial awareness; 3-D shapes; 2-D shapes	Spatial awareness; 3-D shapes; 2-D shapes; Symmetry; Angles
Measures	Length; Weight; Capacity; Time; Money	Length; Area; Weight; Capacity; Time; Money
Data	Recognising and interpreting data	Representing and interpreting data

(NCCA, 1999b, p. 10)

Appendix C: Letter of Invitation



Singing Sums: Investigating the Integration of Song Singing in the Teaching and Learning of Mathematics from Junior Infants to Second Class

Letter of Invitation

1st November 2021

Dear Participant,

I would like to invite you to participate in a study that I am conducting on the integration of song singing in the teaching and learning of mathematics from junior infants to second class. I hope that the findings of the study will inform teachers about the possible integration between song-singing and mathematics in the junior classes and the findings will be included in my research dissertation.

Your participation would involve a 20–25-minute, one-to-one interview over *Zoom*. This research is being supervised by Richard Coady. Please take your time to read through the details of the study in the Project Information (attached) and if you agree to participate, please sign, and return the attached Consent Form by email to X@momail.mie.ie.

Your input would be very valuable to this study. Thank you for your time and consideration.

Kind regards,

Clodagh Ní Dhaltúin
Professional Master of Education
X@momail.mie.ie
(085) XX XX XXX

Appendix D: Information Letter

Singing Sums: Investigating the Integration of Song Singing in the Teaching and Learning of Mathematics from Junior Infants to Second Class

ABOUT THE RESEARCH

I am a 2nd year student studying the Professional Master of Education in Marino Institute of Education. This research will explore the integration of song singing in the teaching and learning of mathematics from junior infants to second class. The aim of this research is to provide critical insights into the perspectives and experiences of primary teachers on using song singing in primary school and how it can be integrated into the teaching and learning of mathematics from junior infants to second class. I have always been interested in learning more about the use of teaching mathematics using song-singing and I hope that this research will improve my practice and the practice of others by using evidence to better understand this opportunity for integration in the junior classes. This is important because the National Council of Curriculum and Assessment have outlined the importance of a more integrated approach to teaching and learning in the junior classes.

This dissertation research is being supervised by Richard Coady. Only my supervisor, the research methods course leader, and I will have access to the personal data you provide. You are free to contact the course leader, Clíodhna Martin (cliodhna.martin@mie.ie) should you have any questions or concerns about the study.

PARTICIPATING IN THIS RESEARCH

Participation in this research involves a 20–25-minute interview on *Zoom*. The interview will explore key questions related to the teaching of song-singing and mathematics, and the opportunity for integration between these areas. If you allow, the interview will be recorded by the *Zoom* recording platform to help with data analysis.

Your participation is voluntary, and you have the right to withdraw from this research for any or no reason, and at any time. The information you provide will only be used for the purpose of exploring the research question set out above and will not be reused. In line with General Data Protection Regulation (GDPR) legislation, only essential personal data will be collected, and all identifiers will be disaggregated from the data as soon as possible after collection. MIE will be the Data Controller for GDPR purposes. With your consent, your personal data will be shared with my research supervisor but not with any other third party. Personal data will be destroyed upon completion of the research dissertation.

When reporting on the information you provide, your data will be presented using numeric identifiers and pseudonyms. Your anonymised data will be aggregated with information from other participants and documentary sources. Anonymised data will be shared in my dissertation and other research related activities e.g., presentations, journals, conferences.

Kind regards,

Clodagh Ní Dhaltúin
 Professional Master of Education
 X@momail.mie.ie
 (085) XX XX XXX

Appendix E: Consent Form



Singing Sums: Investigating the Integration of Song Singing in the Teaching and Learning of Mathematics from Junior Infants to Second Class

Consent Form

If you are happy to participate in this study, please complete the following consent form and return it to me by email to X@momail.mie.ie

I understand and agree that:

I am over 18 years of age

The Project Information has been communicated to me

I am aware that I can withdraw from this project at any time up to when my data has been anonymised and amalgamated

I will participate voluntarily without incentive

My data being treated with confidentiality and anonymity

I will take part in a *Zoom* interview, lasting between 20-25 minutes

My interview will be recorded using *Zoom's* recording platform

My personal data may be shared with the research supervisor

My anonymised data may be shared in this dissertation and via other research activities as they arise.

Name
(PRINTED):

Name (Signature):

Date:

Appendix F: Interview Schedule

Introductory Questions

- How many years have you been working as a primary teacher?
- How many years have you taught in the junior classes (junior infants to second class)?
- What type of school do you work in?
- Do you sing or play a musical instrument for pleasure? If yes, can you tell me more about your musical background?

Perspectives and Experiences of Using Song Singing in Primary School

- Prior to the COVID-19 regulations, can you tell me about your experiences of using song singing in primary school?
- Can you describe the benefits (if any) of using song singing in the junior classes?
- Can you ascertain the challenges (if any) of using song singing in the junior classes?
- In what curricular areas have you used song singing? Can you give any examples of this?

Perspectives and Experiences of Teaching Mathematics in the Junior Classes

- Can you tell me about your experiences of teaching mathematics in the junior classes?
- What are the main challenges (if any) you face when teaching mathematics in the junior classes?
- If you had one change to make to the mathematics curriculum in the junior classes, what would it be?

The Integration of Song Singing in the Teaching and Learning of Mathematics in the Junior Classes

- Have you considered the integration of song singing with mathematics in junior classes? Can you give any examples of this?
- Could you describe an ideal lesson that uses a song singing and mathematics integration approach in the junior classes?
- Can you identify any obstacles in the integration of song singing and mathematics in the junior classes?
- How do you think the integration of song singing with mathematics in the junior classes could be promoted amongst teachers? Can you give examples of how teachers could be supported in this area?

Appendix G: Sample of Interview Transcript

Interviewer: Have you considered the integration of song singing with mathematics in junior classes? Can you give any examples of this?

Participant:

In terms of song singing, and maths, particularly in the infant classes, I would have used it an awful lot. And in terms of kind of solidifying, counting skills, and kind of, I suppose, with understanding number, and a lot of songs, they say, for example, in teaching infants focused on the number for a week or more, say, you're focusing on the number three, we've done a lot of songs that kind of had, you know, three in it and counting to three, along with actions. And definitely I found it was a great way of kind of solidifying facts for children.

And when I moved into third class, then we relied so heavily on singing to teach multiplication tables, and, and kind of getting that skip counting skill going. And so much so I actually have some of the same children this year in fifth that I haven't had in two years, and one boy still sings a times table song to himself as he is working.

Interviewer: That is very interesting how you have used song singing in mathematics across many class levels. Could you tell me more about the benefits you think song singing has for the teaching and learning of mathematics?

Participant:

There are so many benefits of song singing in maths really and obviously it can be beneficial across the board. Firstly, it would have been like, a great intro, kind of, to the lesson I used to do maths after, after my literacy in the morning. So, it was kind of, I used to use songs, as almost kind of, I suppose my transition or my kind of movement break into that, you know, an intro into my lesson, and we'd recap whatever was kind of going to be coming up that that day, or particular ones, they found challenging. And, and then as they occurred through the lesson, we would sing the song when we got stuck. And I suppose then, like, obviously, that was kind of the beginning, if I was modelling out on the board, we'd sing the song together, we'd say, okay, you know, four fours, or whatever it was 16, and we'd sing the four times table song. And then they would do their independent work. And you could hear like, some of them kind of sing in their way to themselves kind of doing their little song in their head, or, you know, kind of singing this and jotting down their answer.

Interviewer: That is a great example of how you have used song singing in the classroom, but I wonder could you identify any obstacles that could arise from this approach to teaching mathematics in the junior classes?

Participant:

I suppose there are always children who don't like singing but I suppose it's kind of how you sell it. And I will be a big believer in, the more invested and involved the teacher is in these things, that the, the greater the success will be, I probably look like a fool at times in the classroom, you know, it's a bit like pantomime, it's all, you know, singing and dancing. And but I think when you are that enthusiastic and invested, it definitely kind of carries across.

Codes:

Yellow: important to note

Pink: class level

Green: use of song singing for mathematics

Blue: mathematical skills through song singing

Red: benefits for song singing

Grey: children using song singing for learning (independent tasks)

Dark Blue: challenges of song singing (with mathematics)

Appendix H: Ethical Approval

12.03.2021

Ref# SERC-10-03-21-08-PME-1-21

Research Focus/ Title: Academic Year 2020/2021

PME1

Dear Clodagh,

Thank you for your submission to the Student Ethics in Research Committee. Your application was reviewed 10.03.2021 at the SERC Committee meeting and has been approved. Please note, your approval is conditional on your research instrument(s) being approved by your allocated supervisor prior to commencing data collection.

Please note for all future correspondence (including emails) that your Research Ethics Reference Number (RERN) is: 08-PME-1-21

If you have any queries, please do not hesitate to contact me.

Regards,

Dr. Maja Haals Brosnan

Chair of Student Ethics in Research Committee

.....

On Behalf of SERC Committee

Appendix I: Linking Literature Review and Data Analysis Themes

Research Question

Investigating the Integration of Song Singing in the Teaching and Learning of Mathematics

from Junior Infants to Second Class

Literature Review Themes		Data Analysis Themes
Song Singing in Primary School - The Challenges of Using Song Singing in Primary School - Song Singing for Neurological and Memorisation Developments		Song Singing in Primary School - Teachers' Use of Song Singing: Outside and Across the Curriculum
Mathematics in Primary School - The Mathematics Curriculum in the Junior Classes - How Children Learn Mathematics in the Junior Classes		Benefits and Challenges of Song Singing in the Teaching and Learning of Mathematics in the Junior Classes
Integration in Primary School - Theory of Integration - The Integration of Song Singing in the Teaching and Learning of Mathematics in the Junior Classes: Theory and Practice		Responding to the Challenges of Song Singing in the Teaching and Learning of Mathematics in the Junior Classes - CPD Courses - The Development of Song Singing and Mathematical Resources