

Analysing nursery rhymes and songs for use in mathematics learning in the early years

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A research and design project is being undertaken which explores the idea of using songs and nursery rhymes for mathematics teaching for young children (aged 2-4). As part of the project, a scoping literature review and a draft taxonomy were completed and are presented here. There is surprisingly little research on the use of songs and rhymes in mathematics learning, despite widespread reports of practitioners using them often, and evidence suggests that repeated weak claims and grey literature may currently be taking the place of more robust, connected and reliable findings. A draft taxonomy of different ways that songs and rhymes might be useful is proposed, including features such as pattern and structure. A call is made for further research focusing on ways in which songs and rhymes could support mathematics learning, including the use of gesture and movement, and a library curating these is suggested.

Keywords: early years; nursery rhymes; mathematical songs

Introduction

The teaching and learning of mathematics through song has a long history, but a sparse research base. Many sources refer to the value of using songs, rhymes, or *nursery rhymes* (short rhymes, poems, or songs for children that tell a story), but often without much depth or explanation as to the mechanisms behind them as tools, including ways to use them that might help children explore and understand mathematical ideas. For example, one EEF report suggests that children ‘Explore mathematics through different contexts, including songs’ and that ‘Practitioners should take advantage of such time to support mathematical development, for example, by...singing a song’ (Hodgen et al., 2020) but provides no further information, which is typical. Many questions remain unexplored; for example:

- Which songs might be considered most effective for such supporting of early mathematical development and why?
- How can songs and rhymes be best used with young children to explicitly explore mathematical ideas, alongside or around simply singing them?
- What are some particular features of songs and rhymes that children and adults seem to enjoy and/or are effective in prompting mathematical thinking?
- Are there differences between songs and rhymes? What are they?
- What levels of mathematical and/or musical complexity work well with young children, and do they affect one another?
- Which early years mathematical ideas and processes are currently well supported by existing songs, and which ideas do not currently have (well-known) songs or rhymes to support them in English?

As part of a project funded by the University of Delaware, a small team comprised of researchers and practitioners in both the UK and the USA was convened to write several new mathematical songs (with accompanying videos) for young children. This

paper reports on the literature review and analysis that informed the first stage of the project, focusing on the questions:

How does existing research position English nursery rhymes and mathematical songs as tools for early mathematical learning, and which knowledge gaps currently exist?

How could we analyse songs and nursery rhymes in order to support their use in early mathematics education?

What do we know about songs and nursery rhymes in early mathematics learning?

Teaching mathematics using the arts is a topic that has gained more prevalence recently, and connecting mathematics and music has been done for decades if not centuries, although often not formally or empirically (Hartburn & Rycroft-Smith, in press). Using songs and rhymes with young children is an established part of UK preschool pedagogy (Siraj-Blatchford, 1999). Practitioners in nursery, early years and sometimes in lower primary (ages 0-7) often use songs and nursery rhymes in their mathematics teaching, feeling positive towards the use of these tools based on their own experiences, despite a scarcity of good quality research evidence behind them (Hamilton, 2021). Hamilton (p.14) also notes that “speculative, experiential and intuitive theories about using songs in education find their way into peer-reviewed literature without substantiation through carefully collected data.” This is consistent with my literature review, which found almost no good-quality empirical research on teaching mathematics to young children using songs and rhymes, but an abundance of:

- evidence that this was happening
- resources to support practice
- claims without substantial evidence to support them, such as that using songs in mathematics education improves memory, motivation, learning and creativity (e.g. Tisdell, 2019).

There have therefore been suggestions that research in this area could help validate existing practice and practitioners' beliefs (Hamilton, 2021).

Most of the literature that currently exists examining the use of song and rhyme in early learning refers to benefits for literacy and language (Arévalo Fuquen & Cortes Olarte, 2019; e.g. Cousins & Minns, 2023; Kroupová, 2015), with very little focusing on mathematics or numeracy. In one exception, a case study with six-year-olds in India, nursery rhymes such as *One two, buckle my shoe*; *Good morning Mrs Hen*; and *Sing a song of sixpence* were used to explore mathematical concepts with the young learners. The study reported that early numeracy development was facilitated by using rhymes for text comprehension, counting, elementary mathematical operations, and analysing the sequences and patterns present in the rhymes. Children used the rhymes as the basis for a wide range of activities, in which they: explored attributes and representations for numbers, sequences, patterns and collections; classified objects, and described a characteristic of the collection, such as number, shape or size; used maths-related language, e.g. comparatives and positionals; and represented early mathematical operations using objects, pictures and drawings. The authors conclude that it is their suggestion that songs and rhymes can be profitably used to develop children's conceptual knowledge of mathematics, but that further research is urgently needed.

One area where there is a good body of evidence is the idea of embodied learning: that is the use of body movement, gesture, or tracing, as part of

mathematical thinking, rooted in the idea that thinking is based in perception and action. Evidence suggests that using gesture and movement (often alongside words), especially with young learners, is beneficial for their exploration of mathematical concepts (Way & Ginns, 2024). In particular, Way & Ginns suggest that co-speech gestures can enhance learning and aid recall in mathematics, and deliberate use of iconic gestures by the teacher can enhance learning and support vocabulary development, ideas that are particularly relevant for songs and nursery rhymes with movements, dances and gestures. It has been suggested that the role of gesture in mathematical thinking be explored in further research, particularly in investigating how students explore mathematical concepts in embodied ways (Alibali & Nathan, 2012).

The problem of classifying a song or rhyme as ‘mathematical’

It is possible to find elements of structure and pattern in any song or nursery rhyme. This is because all songs and rhymes, and most especially those for young children, contain ideas such as repetition, rhyme, predictability, and cycles, items necessary to make them memorable, accessible and enjoyable (e.g. Clarkson, 2020; Hall, 2021). For example, at first glance, one might say there is no mathematics to be found in this rhyme, well-known from my childhood:

*There was a little girl and she had a little curl
Right in the middle of her forehead
When she was good, she was very very good,
But when she was bad, she was horrid.*

But further scrutiny reveals interesting patterns and concepts that could easily be linked to mathematics. In the lyrics, the idea of opposite (or inverse) and the idea of centre. In the structure, a rhyme pattern of ABCB (or AABCCD if the lines are split up differently), with an extra internal rhyme in line one, which makes it particularly fun to say. It even interrogates the very idea of variation (another lovely mathematical concept) in rhyme, with the humorous ‘forehead/horrid’ punchline, which invites exploration of accent.

However, it is also true to say that some songs and nursery rhymes, to a greater or lesser degree, **explicitly** contain mathematical ideas, concepts, structure, vocabulary and processes. For example, the song *Ten green bottles* shows the process of subtracting or counting backwards from ten to zero; the rhyme *Monday’s child is fair of face* represents the seven days of the week; *As I was going to St. Ives* is even a mathematical puzzle in itself! Some songs also have versions with gesture and movement, some of which may be helpful in exploring a variety of mathematical ideas, for example *round, between, up and down, add and subtract, total, none*. This means that, rather than classify some songs and rhymes as *mathematical* (defined as ‘relating to mathematics’, which opens up a can of worms regarding definitions of *mathematics*) and others as *not mathematical*, I suggest instead considering whether and how a song or rhyme could be **useful** in mathematics education – for example in exploring a mathematical concept, learning a mathematical term, or embodying mathematical thinking through gesture. For this purpose, then, it may be useful to further analyse (versions of) songs and nursery rhymes with an eye for pattern and structure in order to categorise their features and attributes that may support mathematics learning. In the next section, I give some examples of ways that this might be done.

A taxonomy of the mathematical utility of nursery rhymes and songs

When considering the use of songs and nursery rhymes in early years mathematics learning, it seems important to focus not only on utility in terms of mathematics education but also on finding overlaps and blurring boundaries between mathematics and other disciplines, especially music, but also history, language, and dance; things that are a well-established part of interdisciplinary early years practice. Figure 1 is a taxonomy, currently in development, that might begin to capture some of the dimensions of a rhyme or song that could be useful in mathematics learning.

Categorisation	Examples	Examples of use
Mathematical words in lyrics	'Half a pound of treacle' <i>Pop goes the weasel</i>	Connections and allusions (cultural capital) Introducing or calling back to vocabulary Connecting words to gestures, movements or signs (including British Sign Language)
Mathematical process (usually counting, usually backwards) in lyrics	<i>Five little ducks</i> <i>Ten fat sausages</i>	Practising, representing or illustrating mathematical processes Making connections between song (enactive) and iconic or symbolic representations
Overlapping structure in performance (singing in the round)	<i>Row, row, row your boat</i> <i>Twinkle twinkle little star</i>	Listening for and recognising note relationships/harmonies Exploring and representing rhythm Exploring and representing turn-taking, simultaneity and 'parts'
Additive/accumulative (growing pattern) structure in lyrics and song	<i>One finger one thumb</i> <i>keep moving</i>	Practising, representing or illustrating growing patterns Making connections between song (enactive) and iconic or symbolic representations
Subtractive/eliding (replacing) structure in lyrics	BINGO <i>Head, shoulders, knees and toes</i>	Practising, representing or illustrating subtracting or eliding patterns Making connections between song (enactive) and iconic or symbolic representations Playing with speed and complexity
Partitive/comprising structure in lyrics	<i>Baa baa black sheep</i> <i>Good morning Mrs Hen</i>	Practising, representing or illustrating partitive structures Making connections between song (enactive) and iconic or symbolic representations

Figure 1: Draft taxonomy of the mathematical utility of some nursery rhymes and songs

In creating this taxonomy, I found it particularly useful to draw, sketch and illustrate the songs and rhymes as a way of examining their pattern and structure, as well as looking at their sheet music and videos of practitioners using gesture and movement. An example of this is shown in Figure 2. Another proposed future

direction for research is to create a library of these kinds of explainers for use in the mathematics classroom.

Figure 2 illustrates the structure of the song BINGO through a 3x3 grid of colored boxes (green, blue, purple) and a musical staff. Each box contains the lyrics and clapping patterns for the song. The lyrics are: "There was a farmer had a dog, and Bingo was his name-o. B-I-N-G-O B-I-N-G-O B-I-N-G-O And Bingo was his name-o." The clapping patterns are represented by colored squares (green, blue, purple) and 'X' marks. The musical staff shows the melody and lyrics, with a final clapping pattern.

Figure 2: A visual exploration of the structure of the song BINGO

Conclusion

In response to the question *How does existing research position English nursery rhymes and mathematical songs as tools for early mathematical learning, and which knowledge gaps currently exist?* This review found that there is currently no consensus (but some speculative interpretations and untested hypotheses) regarding whether and how the use of songs might benefit young learners compared to other pedagogies in mathematics, despite widespread use in England and other countries, and almost no evidence on mechanisms and models whereby using songs and nursery rhymes might be used *most* effectively to explore mathematics for young children. Hamilton (2021) calls for better collaboration between researchers and teachers on the use of songs and rhymes in mathematics in the early years, with a focus on researchers working harder to bring research evidence into existing teacher practice. This topic is a good example of where research, practice and elements in between (knowledge brokering, grey literature, curriculum, teacher support materials, professional learning) are not yet well aligned, and lack coherence. Further research, knowledge brokering, and design are urgently needed to help bridge this misalignment and to offer support materials for practitioners that analyse in more detail why, when, and how songs and rhymes might support mathematics learning.

In response to the question *How could we analyse songs and nursery rhymes in order to support their use in early mathematics education?* I proposed a draft taxonomy to consider the utility of nursery rhymes and songs in mathematics learning

and beyond. At the very least, it would be useful to have a library of rhymes and songs, along with suggestions on the types of mathematical ideas and processes they might help students explore. As part of this project, we are composing new songs (with accompanying videos and gestures) and considering in greater depth the types of topics, structures, and genres that might support early mathematics learning, and we look forward to sharing our work when complete.

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