Managing Professional Change and Development: An investigation of the observed and perceived values of the use of music in the teaching of mathematics within the EYFS and Year One

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Abstract
This paper investigates the effectiveness of using participatory singing and song for teaching of the days of the week in mathematics in year one. It also investigates the attitudes of teaching and support staff to the use of singing and song as a teaching method within the Early Years Foundation Stage (EYFS) and year one. Although using a very small sample (including a control group) statistical analysis suggests that further investigation of the use of participatory song as a teaching method for this area of learning would be supported by the results. An interesting divergence in attitudes to singing and song are shown between EYFS and year one staff – with EYFS staff much more confident in and positive about the use of song than their year one counterparts.

Introduction
Development Matters (Early Education 2012) and the National Curriculum (Department of Education 2013) cover a broad range of subjects, which are approached as discrete subjects within some schools, and by using a cross-curricular, or topic based method in others. The cross-curricular model is especially common in the Early Years Foundation Stage (EYFS) as it focuses on areas of learning rather than subject specific progress measures. Within either approach music is frequently an area where teaching staff are less confident than in other subject areas (Mills 1989). Hallam et al. (2009, p.221) surveyed 341 trainee primary school teachers and reported that whilst 91% were confident in their general teaching ability, only 47% were similarly confident in teaching music and 45% with singing to their class.

The focus of this research is not teaching music as a discrete subject, rather the use of music to support mathematics teaching. Specifically this research aims to identify whether using singing and song is of benefit when teaching the days of the week within mathematics in Year One, as compared to traditional teaching approaches. Having worked as a community musician for 13 years I bring a positive view of the use of music within education to this research and recognising this inherent bias I have attempted to use my research to explore what reasons, if any, the use of music would be to offer a positive contributor to mathematics teaching.

My research took place within a community primary school in east London. The school is of above average size and is in the process of moving to 3-form entry in all year groups. Currently 60 pupils attend Year One in 2 classes of 30 pupils. School X has an above average number of pupils who have special educational needs (SEN) and also an above average number who have English as an additional language (EAL). The proportion of pupils entitled to free school meals is also very high. The Ofsted School Data Dashboard (Ofsted 2014) shows School X's 2014 achievements at Key Stage One in Reading, Writing and Mathematics were in the bottom 20% - however Ofsted (2011) acknowledge that Pupil Progress is 'Good', stating that 'From below average starting points in Year

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1, pupil progress accelerates as they move through the school and, by the end of Year 6, attainment is average.' (Ofsted report School X, 2011, p.5). Overall School X is graded as 'Good' with some 'Outstanding' and some 'Satisfactory' features (Ofsted 2011).

Research method

I followed an 'Action Research' strategy within this research during my SBT2 teaching placement within Year One. The 'British Tradition' of action research is practitioner based, with the goal of improvement in practice (McGrath and Coles 2013, p.108). Denscombe (2007) further defines action research as a cyclical approach usually used in 'hands on' small-scale research projects, specifically aimed at affecting change during the research period.

Action research begins with the identification of a problem area - my own identified problem was that many children in the class seemed to be consistently unaware of which day of the week it was. I discussed this observation with the class teacher who revealed that whilst the class had previously been taught the days of the week she felt that some of the children "simply haven't got it yet" and that this area of learning was one she intended to re-visit within the term of my placement on SBT2. Further discussion revealed that the children in question had been observed to not seem fully engaged with the teaching and learning process utilised.

The previous teaching approach had been the use of a YouTube video of a song and animation showing the days of the week, followed by recitation of the days in their correct order using a rote learning method. This had taken place on one occasion during the winter term within a Mental and Oral Starter (MOS) as part of a mathematics lesson. During the MOS, other than when reciting the days, the children had been passive, quietly watching the video. No formal follow up work had been set, with the class teacher relying on observations to assess children's learning.
Using Tripp's (2012, p.46) Why? challenge I sought to propose a hypothesis as to the reason for the children's lack of security of knowledge in this previously taught area.

Why do many of the children not know the day of the week?
Because they did not take on board the previous teaching.
Why? *The class teacher said they did not seem engaged, so perhaps it is because they were not engaged in the activity.*
Why? *Because the lesson did not excite their interest.*
Why? *Because they were not active learners within it?*
Why? *Because the approach used meant that they were mostly passive in roles as 'listeners' or 'watchers', rather than actively participating.*
(Excerpt from reflective journal, 12.2.15).

The examination of the problem through Tripp's (2012) challenge-structure led me to hypothesise that low levels of engagement caused by the children's passive role within the previous teaching activity were a possible causation of 'the problem'. Therefore a possible solution would be to devise an activity that encouraged active engagement.

When working as a community musician I have observed that children of Year One age are usually eager participants in musical activities, often finding them both fun and enjoyable. Research into rote learning shows that the approach has become something of an anathema within education circles (Johnson 2010) with associations of boredom when utilised without follow up application of learning (What is rote learning?, 2012). Although learning the words to a song requires teaching strategies similar to those of rote learning, the memorisation involved is a step toward a further goal – that of participation in the song, thus providing a follow up application of learning.

Skinner and Pitzer (2012, p. 28) discuss the qualities of engaging lessons stating, 'Active participation, engagement and effort are supported by tasks that are intrinsically motivating, inherently interesting and fun' and it is for this reason I chose to investigate the use of singing and song as the vehicle to promote learner engagement. I adapted the theme tune to 'Happy Days' to follow the British standard week, and included lyrics stating which days were school days and which were the weekend days. The song would be participatory; I would teach it to the children who would then join in and sing along and I would also play my guitar within the activity. The intent was that this musical approach would give the activity a 'Wow! factor', promoting participation in, and recall of the lesson and taught material as it would be distinct from other mathematics activities.

My hypothesis therefore becomes 'The use of singing and song in teaching the days of the week will have a measurable positive impact on the learning of those participating through promoting active engagement in learning, and supporting recall of materials taught' – the *Null Hypothesis* (Thomas 2013) of this being that there will be little or no difference in the results of this intervention as compared to a more standard teaching method.

I devised my research approach to include direct observation of one child from each of the five different ability groups within the class through an ordering activity using printed cards showing the weekdays. The first activity would be used to arrive at the baseline data for the study prior to any teaching, followed by two further observations on the two following days after teaching had taken place.

Whilst I felt that the use of baseline data provided from an initial, pre-teaching, activity would support observation of the impact of my approach, I was also aware that learner progress is expected from any teaching method, and that this would make it difficult to identify whether my method had been responsible for any progress observed. McGrath and Coles (2013) highlight that it is difficult to be sure that the action research intervention are the cause of any improvement without a control group. Both Year One classes in School X follow the same weekly mathematics plan and, as the second class would not be taught using my method, this presented an opportunity to form a control group. I sought and received permissions from both class teachers to conduct my research on this basis.

Results from day two's observations (the first post-treatment observation) fed into my teaching session on day three after which a third set of measures were taken. The resultant change to the teaching in this case was an added repetition of the song, which was sung at the beginning and end of the MOS, rather than taught and then sung only once as in the first MOS. This review and input into subsequent teaching methods forms an important part of what Denscombe (2007 p.123) refers to as the 'Cyclical process' of action research as I have shown in Figure 1.

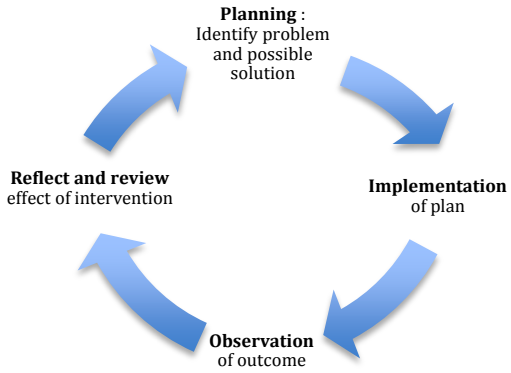

Figure 1. Cyclical action research model.

As a final part of this research I devised a questionnaire that explored teaching staff's valuing of singing and song within the teaching of mathematics and also included a question about confidence and enjoyment of singing activities relating to Hallam et al.'s (2009) study quoted within my introduction.

Ethical considerations for my research were fully considered, and appropriate permissions sought for my observations. As the material being taught formed part of the planned curriculum and my observations were aligned with the usual method of 'booster' activities utilised within School X my mentor and I did not consider that additional permissions from parents were required. The other class teacher was in agreement with this and valued the opportunity for her students to also be observed, with results shared after each observation. As permissions were granted by both class teachers this fulfils the guidelines relating to obtaining collaboration and approval of 'responsible others' for young children (BERA 2011, p.7).

During my observations with the children I explained in clear and appropriate language that the purpose of the work was to assess knowledge and inform future teaching. All observations were positively framed and appropriate praise give to participating students. These steps address the requirement of 'putting participants at ease', and as observations were carried out in an identical format to school 'booster' sessions all legal requirements were adhered to (BERA 2011, p.7). Questionnaires distributed to teaching staff included a consent form, and were hand delivered along with a brief discussion of the research rationale. All staff signed and returned consent forms along with their completed questionnaires, complying with the requirements of voluntary informed consent (BERA 2011, p.6). All data gathered within this research has been anonymised to protect the identity and privacy of participants (BERA 2011, p.7).

Literature review

Within the new national curriculum programme of study for mathematics the statutory requirement relating to days of the week is - 'recognise and use language relating to dates, including days of the week, weeks, months and years' (Department of Education 2013, p.9). These requirements are somewhat vague and have therefore been further broken down within School X's (2014) medium term mathematics planning into the Learning Intentions:

- Know days of the week in order,
- Know that seven days make up one week,
- Know which days are school days and which days are the weekend days.

Learning the days of the week is a sequencing, or ordering activity, following the 'stable order principle' (Gelman and Gallistel 1978, p.79). Whilst the stable order principle is usually applied to number words used for counting Fuson et al. (1982) apply the key elements of the principle to the sequence of the days of the week referring to these as 'Sequence Words'. This application of Gellman and Gallistel's (1978) principle seems sensible given that the order of days is fixed, regardless of starting point.

Fuson et al. (1982, p.57) go on to describe two consecutive stages of recall. Firstly, the 'unbreakable chain' where learners must recite the complete sequence to answer 'what comes before / after?', followed by the 'breakable chain' where learners are able to access the sequence from points other than the beginning. My use of song was intended to support a conventional development of the correct, or 'stable', word order through the creation of a mnemonic, or aide memoire. Given the short time scale of my research the children taught using my method would likely produce an 'unbreakable chain', utilised through 'singing the song in their heads' if using the song in this way. Goeghegan and Mitchelmore (1996) discuss mathematics learning through a constructivist framework and conclude that such learning hinges on 'active attentiveness' (ibid. p.62). Constructivism is a developmental theory based on the work of Piaget. Ackerman (2002) provides a useful summary of Piaget's constructivist learning theory in the context of education stating that:

- Teaching is always indirect i.e. children don't just 'take in' knowledge, they interpret it based on their prior knowledge and experience,
- Knowledge is not information that is simply received, categorised, memorised, retrieved and applied by children – rather knowledge is experience acquired through interaction with the world, people and things.
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The activity of learning a song alongside the ordering of the days of the week gives the children participating a real world experience with which to connect the learning, allied with their previous knowledge i.e. previous songs learned and sung.

Song et al. (2013, p.3) begin their paper stating that 'The traditional method of [mathematics] instruction may be ineffective, because it is unable to reach all students and meet their needs'. Their paper focuses on the intrinsic motivation of learners as a key element to learning within mathematics stating that 'Students who are intrinsically motivated are more likely to exhibit initiative, independence, sense making and enjoyment in learning mathematics…' (ibid. p.5)

Song et al. (2013, p.5) also suggest that mathematics instruction integrated with music can be effective in increasing students' intrinsic motivation, because it 'fosters an enjoyable learning experience in which students may be more aesthetically engaged'. Goeghegan and Mitchelmore (1996) state that a child cannot learn or participate in music activities without 'active attentiveness' and conclude that musical experiences may be one effective way (although they note, not the only one) of promoting this. This proposed idea of 'active attentiveness' would seem aligned with the intrinsic motivation discussed by Song et al. (2013) as such attentiveness within an activity would be the likely result of intrinsic motivation to participate. These acknowledgements of music activities as possible supports to increased motivation and engagement in learning support investigation of my hypothesis.

Geist et al. (2012) state that children learn mathematics through active cognitive engagement 'in as many ways as possible' (ibid. p.74) and that such learning is a developmental process influenced by physical, socio-emotional and cognitive factors best supported by a stimulating mathematical

environment. Their study also shows that music is a useful tool for offering experiences promoting a positive attitude towards mathematics in learners. A separate study carried out by Geist (in 2009) included interviews with children who had participated in music activities during mathematics teaching, with all but one participant reporting back describing the mathematic activities and concepts that included music. The control group however had difficulties recalling the mathematical activities taught (ibid. p.76). These interviews, whilst anecdotal, seem to support the idea that music activities integrated with mathematics promote enjoyment, participation and recall of the mathematics work more successfully than the same work carried out without a musical element. This in turn supports the use of 'Wow! factor' I intended through teaching using singing and song, supported by my guitar playing.

These foci of intrinsic motivation, active attentiveness, and active cognitive engagement through the use of music as a teaching activity (Goeghegan and Mitchelmore 1996; Geist et al. 2012; Song et al. 2013) ally themselves with the qualities of engaging lessons as described by Skinner and Pitzer (2012). This further support my intention to utilise singing and song as an activity that is intended to be actively engaging and promote intrinsic motivation through being participatory, enjoyable and fun.

Gardner's (1993) theory of multiple-intelligences (MI) puts forward 7 individual intelligences possessed by humankind, and proposes that every human possesses each of these, differing only in how developed each is and in what combinations they are utilised:

1. Linguistic – relating to written or spoken language,
2. Logical-mathematical – relating to reasoning and calculating, the use of logic, number and abstract thinking,
3. Visual-spatial – relating to mental visualisation of space and objects,
4. Body-kinesthetic – relating to the physical use of the body,
5. Musical – relating to participation in or the creation of music,
6. Interpersonal – relating to relationships with others,
7. Intrapersonal – relating to self-reflection and understanding of one's own emotions, motivations and behaviours.

Kornhaber (2001) puts forward that MI theory is verified within education by the everyday experience of educators observing that each student thinks and learns in a different way. Fierros (2004, p.13) supports this stating that 'The key to MI is that it changes the way educators think about how students learn'. Kornhaber (2001) suggests that the conceptual framework MI theory provides allows interesting opportunities for reflection on teaching practices, with these reflections leading 'many educators to develop new approaches that might better meet the needs of the range of learners in their classrooms' (ibid. p.276). Smith (2002, 2008) supports this point agreeing that MI theory provides a useful framework for questioning practice by providing a basis for a broader focus for reflection. I find these ideas to be a fascinating framework for my own observations of children's varying learning styles, and an interesting extension to the visual, audio, kinesthetic (VAK) model of teaching (Fisher 2014).

Gardner (2006) identifies that the traditional focus of education has been to address only the linguistic and logical-mathematical intelligences therefore utilising only the skills supported by these intelligences. Discussing the use of the arts in teaching mathematics Gardner (1993, p.17) suggests that during these non-traditional mathematical learning experiences students are able to connect their mathematical intelligence with other intelligences utilised by the activities, thus increasing potential for learning. Applying MI theory to my hypothesis suggests that by engaging the musical

and body-kinesthetic intelligences as well mathematical and linguistic intelligences of the pupils participating I would therefore increase the potential for learning for all students, further supporting that my hypothesis is worthy of investigation.

Analysis

There are some limitations to the approach I have used within this research project, firstly that the number of participants is very small (total of 10). The importance of the size of the sample group is particularly significant when interpreting the results of the research, especially when calculating the statistical significance of any findings (Howard, 2013). A further limitation of this research is that constraints of time and the demands of other teaching commitments whilst on SBT2 meant that my hypothesis was only tested on one occasion. This limited testing has a similar effect on interpretation of results as the small sample size (Howard 2013).

To form my participant groups both class teachers selected one child from each of their 5 mathematics ability groupings whom they had observed to not be secure in their knowledge of the days of the week. I intended that this approach would allow me to have a directly comparable control group, which Thomas (2013, pp. 163-164) defines as an 'extra group, as alike as possible to the first' which 'serves as a basis for comparison… [receiving] no experimental manipulation'. In order to maintain the integrity of the research I carried out identical observations with members of each group at identical points in the teaching structure.

My baseline analysis shows that although the subjects were from comparable mathematical ability groups, baseline knowledge varied greatly between the two classes, with a baseline mean for the treatment group of 1.8, and of 0.4 for the control group. In order that improvement is directly comparable I have therefore shown any improvement over the course of the research as percentages of increase against the total improvement possible.

				% Increase against total possible improvement		
	Day 1	**Day 2**	**Day 3**	**Day 1-2**	**Day 2-3**	**Day 1-3**
Total treatment group	9	21	29	46.15%	57.14%	76.92%
Total control group	2	5	18	9.09%	43.33%	48.48%
Mean treatment group	1.8	4.2	5.8	46.15%	57.14%	76.92%
Mean control group	0.4	1	3.6	9.09%	43.33%	48.48%

Figure 2. Totals and mean values for 1:1 ordering activity and % increase against total possible improvement.

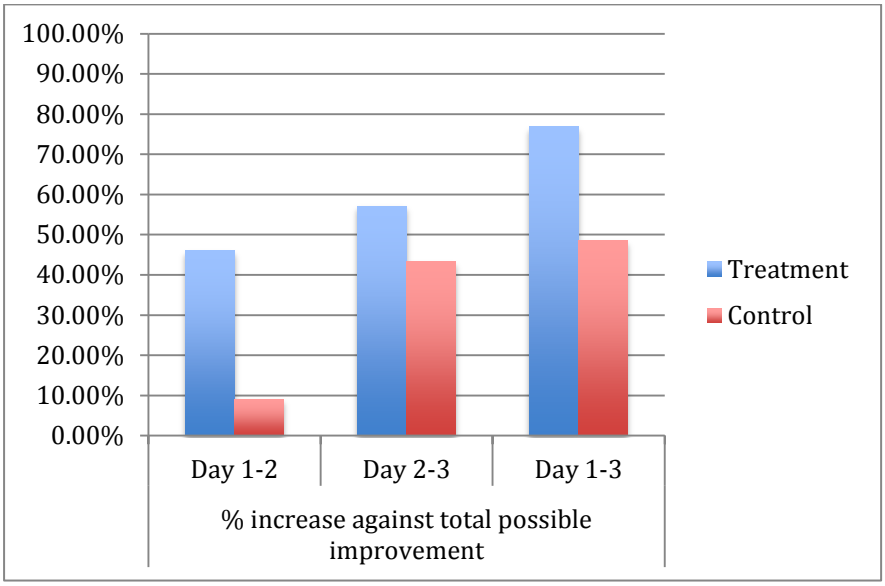

Figure 3. Graph showing percentage improvement against possible improvement in total group scores.

Although an 'eyeball' (Thomas 2013) of the statistics and graph above appears to show that whilst both groups have improved that the treatment group have improved significantly more, in order to show whether these improvements are significant further statistical tests are required. Investigation of variance using standard deviation shows the variance of each individual result from the mean of that group (Thomas, 2013), and I have applied this to the overall improvement score of each individual in both my treatment and control groups.

The standard deviation shows no large variance in either group's overall improvement in score (see figure 4 below), and as the variance for both groups is comparable this further suggests the validity of performing a *t* test. A *t* test shows the likelihood of two sets of results being found by chance and the result of a *t* test shows the actual significance figure (the p value) with any figure below 0.1 (less than 10%) being seen as statistically significant (Thomas, 2013). In the case of my study the small sample number will invariably have an effect on the results of a *t* test as the probability of results occurring by chance is greater within smaller samples.

I have chosen to perform a one tailed *t* test as my hypothesis suggests only one outcome; improvement in results through the use of singing and song, as compared to a traditional teaching method, with the null hypothesis being no significant difference through utilisation of this method. I have selected an unrelated *t* test as there are different teaching methods being used with different individuals within each group and therefore the groups are categorised as unrelated, as defined by Coolican (1990).

	Number correct			Overall increase in score
	Day 1	Day 2	Day 3	
TMHA	1	6	7	6
TMUM	4	5	7	3
TMMM	3	5	7	4
TMLM	1	4	4	3
TMLA	0	1	4	4
Standard deviation (SD)				1.224744871
COHA	1	1	4	3
COUM	0	1	4	4
COMM	0	0	5	5
COLM	1	1	3	2
COLA	0	2	2	2
Standard deviation (SD)				1.303840481
t test result on individual improvement scores (between both groups)				0.173296754

Key –

Groups

TM = Treatment group

CO = Control group

Individual's mathematical ability groupings

HA = High Ability

UM = Upper Middle

MM = Mid Middle

LM = Low middle

LA = Low ability

Figure 4. Table showing individual scores, overall improvement, standard deviation within groups and *t* test results for comparison of overall improvement scores.

The *t* test result shown in figure 4 would not be considered statistically significant as it is above the 0.1 threshold, however as stated above this is influenced by my small sample size. Due to this influence I interpret that the result's proximity to the significant figure suggests that further testing of the hypothesis with a larger sample group would be worthwhile.

Questionnaire responses

I gave questionnaires to all of the four teaching staff within Year One and also gave questionnaires to the eleven EYFS staff working at School X. All 15 questionnaires were completed and returned. Each questionnaire had 5 questions with a numbered response, and space for comments – although most respondents opted not to include comments.

Question 1

Do you use singing and song within teaching / support sessions for mathematics / numeracy?

Responses

1. Often 2.Sometimes (where a known song addresses topic)
3. Rarely 4. Never

	Response 1	Response 2	Response 3	Response 4
Year One staff				
Teachers (2)		**2**		
TAs (2)		**1**		**1**
EYFS staff				
Teachers (4)	**3**	**1**		
FSOs (5)	**3**	**2**		
TAs (2)	**2**			

These responses show that singing and song is more often utilised within the EYFS than within Year One in the teaching of mathematics / numeracy.

Question 2
What value do you perceive / observe singing and song have in the teaching or support of mathematics / numeracy?

Responses
1. Extremely useful 2.Useful sometimes (where known song addresses topic)
3. Rarely useful 4. Never useful

	Response 1	**Response 2**	**Response 3**	**Response 4**
Year One staff				
Teachers (2)		**2**		
TAs (2)		**2**		
EYFS staff				
Teachers (4)	**4**			
FSOs (5)	**3**	**2**		
TAs (2)	**2**			

These responses show that singing and song is more highly valued within the teaching of mathematics / numeracy by EYFS staff by Year One staff.

Question 3
What value do you perceive / observe singing and song have in the teaching or support of ordering mathematics/numeracy activities (e.g. number order or days of the week)?

Responses
1. Extremely useful 2.Useful sometimes (where a known song addresses topic)
3. Rarely useful 4. Never useful

	Response 1	**Response 2**	**Response 3**	**Response 4**
Year One staff				
Teachers (2)	**1**	**1**		
TAs (2)		**2**		
EYFS staff				
Teachers (4)	**4**			
FSOs (5)	**5**			
TAs (2)	**2**			

These responses show that singing and song are highly valued within the EYFS when teaching ordering, and that less value is placed on this by Year One staff.

Question 4
Do you consider yourself to be a confident singer in a classroom teaching / support situation?

Responses
1. Yes 2.No

	Response 1	Response 2
Year One staff		
Teachers (2)	**1**	**1**
TAs (2)		**2**
EYFS staff		
Teachers (4)	**3**	**1**
FSOs (5)	**4**	**1**
TAs (2)	**2**	

These responses show that whilst the EYFS staff team are confident when singing in class than the majority of the Year One staff team are not.

Question 4 a
Do you enjoy singing in a teaching / support situation?

Responses
1. Yes 2.Sometimes 3.No

	Response 1	Response 2	Response 3
Year One staff			
Teachers (2)	**1**		**1**
TAs (2)		**1**	**1**
EYFS staff			
Teachers (4)	**4**		
FSOs (5)	**4**	**1**	
TAs (2)	**1**	**1**	

These responses show that the majority of the EYFS staff team consistently enjoy singing in teaching/ support situations whereas the Year One staff team includes members who do not.

Conclusions
As shown within my analysis the results of my observations suggest that the use of singing and song within the teaching of the days of the week has had a positive impact on the improvement in security of knowledge of those pupils observed. The lower levels of improvement shown in the control group further corroborate this. Despite the generalisability of these results being limited by both the small sample group and the fact that there was only a single testing opportunity (Thomas 2013) I believe that the levels of improvement shown within my treatment group, as compared to the control group, demonstrate that further investigation of the use of singing and song this context would be worthwhile.

My reading in the areas of increased pupil engagement and intrinsic motivation through active participation (Goeghegan and Mitchelmore 1996; Skinner and Pitzer 2012; Song et al. 2013), and in allowing pupils to engage with a mathematics activity in non-traditional ways (Gardner 1993; Kornhaber 2001; Geist et al. 2012), supports that the use of singing and song as a teaching method is a probable causation of increased engagement of pupils, and that any improvement in learning would likely be influenced by this.

Both the findings of my research and my reading suggest that increased use of singing and song as an approach to teaching of ordering within Year One would be beneficial to learners. Within my intervention action plan I have suggested that utilisation of this approach within Year One would be advisable.

Questionnaire responses show that the use of singing and song is more frequent, and more highly valued within the EYFS than within Year One, by staff who are more confident in its use. Again the generalisibilty of these findings are limited by the small sample size, and by the imbalance in numbers in each group (Year One staff = 4, EYFS staff = 11). However the overwhelmingly positive response of EYFS staff, including their comments, and the fact that their responses indicate that this method is regularly utilised support the idea that it would be worthwhile exploring similar methods within Year One.

The responses of EYFS staff within School X suggest that there would be regular opportunities for Year One staff to observe this method in action, and in my intervention plan I have recommended that such observations take place.

Year One staff will teach children who are currently in Reception in the next year of their schooling so would benefit from these observations by; a) observing and developing techniques of teaching familiar to these pupils and, b) observing their new pupils participation, engagement and learning from these methods. The intention of this recommendation is also that through these observations Year One staff would have an opportunity to revisit their opinions of such methods from a standpoint other than their own personal practice. As responses to my questionnaire indicate Year One staff have less positive viewpoints of, and lower confidence in singing I have also recommended training, which could be provided by EYFS staff during staff or phase meetings, or by external facilitators.

Through this research I have explored a number of areas of theory concerning pupil engagement, motivation, learning, and also the use of music within mathematics teaching. This process has been fascinating and informative, developing my knowledge and understanding in these areas, as well of the education research process itself. One implication from this research for my future practice is to further develop my repertoire of song to include songs addressing areas of teaching similar to those tested within this research, and when employed within a school to both utilise and champion the use of these methods.

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