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Teaching mathematics with children's literature in Finland

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Abstract

The Finnish school system will transfer to the new Core Curriculum for Basic Education 2014 in 2016. The new curriculum emphasizes integration of subjects. In Finland, mathematics and the mother tongue are the two subjects which are taught the most and therefore play a significant role in every primary teacher's weekly routine. Unlike English-speaking countries, Finland lacks children's literature aimed towards use in mathematics teaching. This study aimed to understand teachers' and teacher-trainees' points of view on *the extent to which they use children's literature in teaching mathematics in primary school and how to efficiently use children's literature in teaching mathematics in primary school*. This study was a part of an international study entitled 'Teachers' beliefs on the integration of children's literature in primary mathematics learning and teaching: A comparative study', including universities from England, Hong Kong, Australia, and Finland. The aim was to determine teachers' beliefs concerning integration of children's literature into mathematics teaching and to the extent to which this benefits learning. Data collection was conducted via web-based questionnaires translated into Finnish from spring to autumn 2015. Mixed methods data analysis showed that teachers/teacher-trainees do not use children's literature in mathematics teaching, but they still recognize various ways to implement it into their teaching. Previous studies on the use of literature in mathematics teaching show that children's literature may provide a meaningful context to develop mathematical skills and foster children's positive attitudes towards mathematics, as the stories in the literature are presented in an engaging and approachable manner.

Keywords: Mathematics, children's literature, teaching.

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1. Introduction

This article presents a study, which is a part of an international research project entitled 'Teacher's beliefs on the integration of children's literature in primary mathematics learning and teaching. A comparative study'. The aim of the project is to ascertain the extent to which the integration of children's literature into primary mathematics lessons benefits children, makes integration of different contents more effective, and enhances attitudinal changes towards mathematics and literature from the perspective of teachers of different personal and professional characteristics in England, Hong Kong, Australia and Finland (e.g. mathematics and literature, Billings & Beckmann, 2005; Caparo & Caparo, 2006).

This article focuses on the educational possibilities of connecting children's literature to mathematics learning from the perspective of Finnish class teacher-trainees and teachers. Two subjects, mathematics and the mother tongue, are taught the most in Finland. These two subjects consume a great deal of teachers' weekly teaching hours. The national core curriculum for basic education in Finland is to be revamped by the end of 2016, and this will involve changing the educational approaches toward more holistic education. This study is based on the new curriculum, since the aim of the holistic approaches is to offer students integrated learning experiences by integrating school subjects together (Finnish National Board of Education 2014). Literature and literacy could offer major resources to different holistic approaches. Some researchers even suggest that fictional literature could be central to all learning (Toivonen, 1998). At best, holistic approaches increase the learner's subject area knowledge and understanding as well as improve learners' attitudes, thinking, and evaluation methods (FNBE, 2014). Since mathematics and the mother tongue play a significant role in every primary teacher's weekly routine, there should be research-based approaches to integrate these two subjects together.

There is already some research-based evidence on the possibilities of using literature in mathematics lessons, but unlike English-speaking countries, Finland lacks children's literature aimed especially at use in mathematics teaching. There is no prior research on the use of children's literature in mathematics in Finland. Connecting children's literature with mathematics lessons can spark students' interest, engage them in mathematical cognition, reduce anxiety, and enhance the positive relationships between teachers and students and student peers. Children's literature can especially be used to foster learners' understanding and to solve different mathematical problems, as learners' can empathize with the situations in children's literature (Flevaris & Schiff, 2014). At best, children's literature has the potential to differentiate learning contents of mathematics based on students' different learning capacities (Courtade, Lingo, Karp, & Whitney, 2013).

This study intends to understand teachers' and student teachers' points of view on the extent to which they use children's literature in teaching mathematics in Finnish primary schools and how to efficiently use children's literature in teaching mathematics in Finnish primary schools.

1.1. Fiction in primary school mathematics lessons

1.1.1. The natural connection of mathematics and literature

When children become acquainted with children's literature, they probably will not immediately associate it with mathematics. However, teachers of different levels have started to recognize the potential of literature in supporting children's mathematics learning (Flevaris & Schiff, 2014). First, the use of children's literature benefits all sorts of communication in mathematics and creates meaningful contexts for mathematical tasks. In addition, children's books present interesting problems and equip children with problem-solving models. This is connected to the fact that reading can be comprehended as a problem-solving process and a constructive process, meaning that integrating mathematics and literature could be effective: integration not only develops mathematical skills but also literacy, mathematical language, and problem solving (Wiburne & Napoli, 2008).

According to Anderson, Anderson, and Shapiro (2004), using literature for learning about mathematical thinking and mathematical concepts starts before children enter school. In many families, bedtime reading is an occasion where mathematical questions are discussed, since the conversations after shared reading sessions may focus on mathematics. This means that children are already used to posing mathematical problems through literature before entering school. However, each family has its own tradition of connecting mathematics to reading, and interfering with this tradition might threaten the enjoyment of shared reading and discussing mathematical problems.

There is a wide range of children's literature in English which is specially aimed at teaching mathematics; however, this is not the case in Finland. In Finland, there are only a few children's books that are specially written for facilitating mathematics teaching. Perhaps the most popular book, and the only book published as a fiction work for older students, is the novel *Tehtava maassa (Mission in Earth, 2010)*. It is a story about Finnish children who are not interested in mathematics. The children are being helped by an alien from the planet Mathematia. The book is written by a math teacher named Markku Sointu and an author named Anneli Kontu. The other children's books consisting of mathematical contents are either meant to be learning materials or targeted at small children who are just learning about numbers. In addition, Finnish schoolbooks for mathematics often include small stories for teachers to use. However, the common type of mathematics teaching in Finnish elementary school can be considered to be strongly schoolbook centered, and there is not a very strong tradition of using other material in lessons (Leino, 2008). Despite the small amount of literature aimed at learning mathematical concepts in Finland, there are a lot of books which could be used as a part of mathematics lessons, as one of the definitions of mathematics literature is that it is any piece of literature that has the potential to engage children in mathematical conversations (Nesmith & Cooper, 2010; Flevaris & Schiff, 2014).

Selection of literature for mathematics lessons must be done carefully. In order to help teachers to choose suitably motivating reading material for mathematics lessons, Hellwig, Monroe, and Jacobs (2000) created an evaluating tool with five perspectives. The perspectives are 'accuracy', 'visual and verbal appeal', 'connections', 'audience', and the "wow" factor'. According to Hellwig et al., only a few books score high in all criteria, but the criteria will still help to determine the strengths and weaknesses of certain books. There are also more detailed criteria for evaluating the potential of children's books in mathematics lessons, which among other things involve the visibility and developmental appropriateness of math contents (e. g. Hunsander 2004). Some researchers focus on the illustrations in children's books. At best, the illustrations in picture books visualize mathematical problems for learners, especially if there is a correspondence between the text and illustrations (Marston, 2010; Oers, 2013). According to Flevaris and Schiff (2014), teachers should obtain guidance from research on selecting and using children's literature in their mathematics teaching.

1.1.2. Pedagogical approaches to enhance the use literature in mathematics teaching

There are various pedagogical approaches to connect children's literature with mathematics. Literature engages and socializes children in shared reading and learning in mathematics lessons. According to Schatzer (2008), conversations connected to shared reading of children's literature visualize the formation of mathematical problems and connect them to students' lives. These connections may happen spontaneously, but it might sometimes be wise to support the emergence of this connection using the help of a more advanced reader and more skillful mathematicians (Vygotsky's 'zone of proximal development'). Literature is commonly used before conducting hands-on activities in mathematics lessons to bridge the relevant concepts with students' prior knowledge and hands-on activities (Flevaris & Schiff, 2014). An important aspect of using literature in mathematics lessons is the fact that the act of reading and discussing literature includes modeling activities and may help to pose problems, provide information, offer a context, and provide compelling characters for modeling (English, 2010).

Haapasalo (2008) writes that mathematics learning often involves the dictation of procedural and conceptual knowledge. Procedural knowledge includes algorithms and procedures in order to complete the task but it does not require understanding of a concept. Conceptual knowledge is a semantic net which requires one to understand the logic and connections of the subject being learned. It should be acknowledged that both procedural and conceptual knowledge are essential to the learning process. Mathematics teaching using children's literature requires the combination and integration of two subjects which in turn requires the conceptual knowledge approach.

In addition to learning specific mathematical concepts, literature is considered a powerful tool for supporting children's emotional and social growth in mathematics lessons. The ability to feel empathy and understand fiction are closely related because both require empathizing with someone else's feelings, situations, and actions (Hynds, 1990; Nussbaum, 1995). Contemporary literature education emphasizes that literature be frequently used to support the maturation process and provide information on different aspects of life (Nikolajeva, 2013; Rikama, 2005). Learning through fiction can be more efficient than learning through facts because the reader is more involved in the process of making sense of the text. The dual effect of learning involves participating in the process of learning through conscious and subconscious understanding and thereby enhancing the learning to make it more effective (Piazzoli & Kennedy, 2014). By empathizing with the characters of a certain story, children can learn valuable features and models of behavior for their future life. According to Hong (1996), children's literature has positive effects on children's attitudes, persistence, and motivation towards mathematics learning and children show increased preference for mathematics after an intervention with picture books.

As mentioned earlier, literature used in mathematics lessons for educational purposes must be selected carefully. It is, of course, vital to confirm that the mathematical concepts are correct but it is also important to select literature appropriate for children of different backgrounds (Edelman, 2012). According to prior research, literature can form an especially effective tool for those with different native tongues and for those from lower socioeconomic backgrounds, and for girls (Hefflin and Barksdale-Ladd, 2001; Hellwig, S. J., Monroe, E. E., & Jacobs, J. S., 2000). It is worth noting that there is evidence that children's literature benefits girls' mathematical skills and that using literature in contexts other than literature lessons benefits boys' reading skills (Grossman, 2001). Therefore, children's literature can be beneficial to all learners in mathematics lessons.

2. Research design and analysis

This study used a qualitative research design which was supported with quantitative data (see e.g. Cohen, Manion, & Morrison, 2007; Creswell, 2011; Teddlie & Tashakkori, 2011). This study approached the data using mixed methods analysis by observing both open-ended questions and recoding them into numeric expressions in a quantizing way (Teddlie & Tashakkori, 2011). This was done to observe the possible statistical relations of the data. To preserve the validity of the research, the researchers both coded the open-ended questions separately into categories which were later compared between the researchers and then combined after discussion.

The data were collected using a questionnaire survey, which was the same across the project countries. In this study, the questionnaire survey was translated to Finnish and, to increase the trustworthiness of the study, back-translated to English. The questionnaire included both open-ended and structured, closed questions. The use of closed questions provided frequencies and categories to observe and test the data using statistical methods (Cohen et al., 2007). The questionnaire aimed to determine the current practices and abilities with regard to literature use in mathematics teaching and the attitudes towards literature use. The questionnaire was distributed through Facebook groups as a part of the courses offered by the University of Turku at the Department of Teacher Education in Rauma, and through e-mail. The participants answered through Webropol, which is a web-based system for making questionnaires.

The data comprised 64 ($n = 64$) respondents' replies to the questionnaire. Data collection was conducted from spring to autumn 2015. The gender distribution across the respondents was 54 women and 10 men. The mean age was around 36–40 years. The respondents of the study consisted of teacher-trainees ($n = 33$) and teachers ($n = 31$).

The data were mainly analyzed and observed using crosstabulation, as the open-ended question replies were recorded into categories. This provided the opportunity to see how certain answers were set in certain categories. Fisher's exact test was used when appropriate in order to reveal the possible statistical dependency of the recoded variables. Fisher's exact test is suitable for sets of 2x2 tables where the sample size is small (see e.g. Imbens & Rubin, 2015).

3. Results and conclusions

3.1. The amount of children's literature used in mathematics teaching in Finland

The results indicate that children's literature is not used in mathematics teaching in Finland and that Finnish teacher education does not provide tools for using children's literature in mathematics. Most of the participants reported that in the course of their training, they were never taught how to use children's literature in mathematics teaching (Figure 1.).

Only 12 respondents out of 64 answered that they are using children's literature in mathematics lessons. The frequency of teachers using children's literature in mathematics teaching ($n = 8$) was double in contrast to the frequency of teacher-trainees ($n = 4$). Figure 1 presents the frequencies of use of children's literature in mathematics teaching. Out of 12 respondents who were connecting children's literature with mathematics, eight (8) had used it for 10 hours or more during the semester. This implies that those who use children's literature in their mathematics teaching do it frequently.

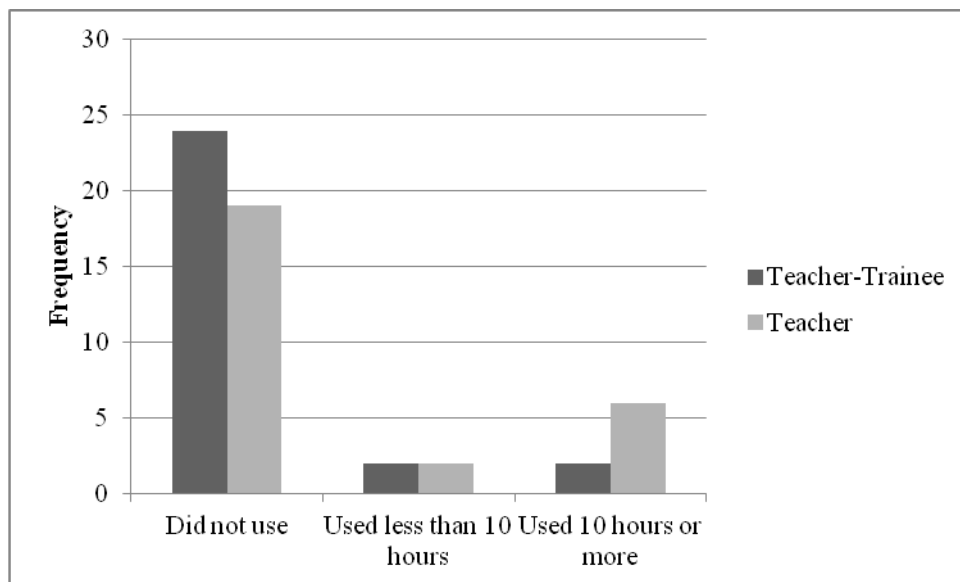


Figure 1. The frequency of using children's literature in mathematics. ($n = 64$)

3.2. The main reasons for not using children's literature in mathematics teaching

Most of the respondents (44 out of 64) provided reasons for not using children's literature in their mathematics lessons. Seven main reasons were found: *Lack of need, lack of time, extended dependency on subject's school books, impossibility of integration of the two subjects, lack of*

knowledge, lack of materials, and the feeling that only small children will benefit from the integration of mathematics and children’s literature (Table 1). It should be acknowledged that many respondents listed more than one reason and thus were coded and observed separately in comparison to other teachers and teacher-trainees.

The lack of ready-made pedagogical materials was the mode, as 16 out of 44 respondents mentioned it as the main reason for not using children’s literature in their mathematics teaching. The next most frequent reason was a *lack of time* to plan and/or use children’s literature in mathematics lessons, which was included in 11 of the 44 replies. Concerning the main reason of *lack of time*, there is a statistically significant dependency ($p = 0,014$) between teacher-trainees/teachers and the reason. It is also the only statistically significant result of the Fisher’s exact test. However, the third most frequent reason was the lack of knowledge of children’s literature and lack of pedagogical approaches for using children’s literature in the mathematics teaching. Of the 11 replies in this category, eight (8) were students’. Taken together, these results imply that if pedagogical materials were available, this would reduce the time needed for the planning and increase knowledge, and therefore enable the use of children’s literature in mathematics.

Table 1. The main reasons preventing the use of children’s literature in teaching mathematics (n = 44).

	Teacher-trainee		Teacher		Fisher’s exact test (2-tailed) p-value
	No	yes	no	yes	
<i>Lack of need</i>	22	1	16	5	0,088
<i>Lack of time</i>	21	2	12	9	0,014**
<i>Extended dependency on subject’s school books</i>	21	2	18	3	0,658
<i>Impossibility of integration</i>	17	6	20	1	0,097
<i>Lack of knowledge</i>	15	8	18	3	0,169
<i>Lack of materials</i>	14	9	14	7	0,761
<i>Feeling that only small children will benefit from the integration of mathematics and children’s literature</i>	18	5	20	1	0,188

**Statistically significant at 0,05 level.

3.3. The main approaches to using children’s literature in mathematics lessons in Finland

Even though there is no specific education on literature and mathematics in Finland, teachers have positive attitudes towards the use of fiction, as 52 out of 64 teachers pointed out that it could be useful to use children’s literature in mathematics teaching. It seems that many Finnish mathematics books in primary education use fictional stories as new teaching contents in order to motivate students. The teachers also pointed out that children usually like stories and stories support motivation and help children to concentrate and visualize learning contents. However, it is uncertain whether the short stories in materials for teaching mathematics could be classified as literature.

It seems that children’s literature is being used in mathematics lessons to some extent but mainly in the early grades of primary schools. This is partly due to the fact that it is easier to find literature for

smaller children and some picture books clearly aim to teach children mathematical contents. In addition, picture books seem to bring the elements of child-centeredness and playfulness to mathematics lessons. The teachers mentioned certain specific mathematical contents which are easily connected to literature. These contents are natural numbers, mathematical symbols, multiplication and written problems. The most common contents taught using children's literature in our study were natural numbers (7 out of 12 teachers used them), which refer to so-called everyday numbers and are used to point out quantity and order, and to name things (naming such as Bus 34). The responses show that some teachers see children's literature from a highly procedural perspective (Haapasalo, 2008), as counting the frequency of letters can be done using any text and not children's literature in particular. It also seems unlikely that children would benefit from this method.

4. Discussion

The pedagogical approaches to using children's literature in primary school mathematics need further development, which is the case in English-speaking countries as well (e.g. Capraro & Capraro, 2006; Young-Loveridge, 2004). It seems that teachers in Finland are not aware of the possibilities of children's literature and are somewhat reluctant to educate themselves on this topic. Therefore, it is important to develop appropriate materials and guides for teachers and make them easily accessible. It is also important to develop such materials and guides for Finnish teachers in particular, as the teaching practices that are effective in one country may not be effective in another cultural context (e.g. Hatano & Inagaki, 1998).

In Finland, there is not enough suitable literature for mathematics lessons and no research-based information on the subject matter. Therefore, it is unsurprising that teachers and student teachers are not familiar with children's literature and that the concept of literature suitable for mathematics teaching is somewhat unclear. Teachers seem to use children's literature in mathematics lessons if it is easily implementable from the perspective of both literature and pedagogical approaches, but they are unable to find time when such literature is not provided as part of the curriculum study books. This is proven by the fact that teachers use children's literature in the early grades, for which literature aimed at mathematical teaching exists, and by teachers' positive attitudes towards the integration of literature, reading, and mathematics.

It is necessary to acknowledge that the current results should be observed carefully and that a greater sample size is needed in order to obtain more competent results.

If we want to enhance the use of children's literature in mathematics lessons in Finland, the need for research-based information, pedagogical approaches, and suitable children's literature is crucial in Finland, since the new mathematics curriculum is very strict and there are many other new pedagogical approaches to mathematics teaching in the new curriculum (FNBE, 2014). At the moment, many teacher-trainees and teachers feel that both planning and using literature-based lessons in mathematics is too time consuming, given the lack of materials.

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