

Don't count on the quality of children's counting books



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Abstract

Children's literature books, more specifically, early counting books, can be an engaging means for exploring numeracy with young children. Although there is general consensus in the current literature supporting the integration of high-quality children's books to teach mathematics; a user-friendly instrument to guide the evaluation of early counting books does not exist. Consequently, I created an instrument to encourage teachers to think more critically about the quality of early counting books utilized to teach mathematics.

The methodology for creating the instrument framework was founded on an extensive literature review and previously developed instruments. The instrument was tested and validated by multiple reviewers, including evaluations by expert in the field (i.e., math consultants, mathematics and Language Arts faculty, education librarians, practicing elementary teachers).

The purpose of this paper is to introduce the instrument; provide an overview of its development and design, including themes to emerge from the literature which form the foundation for the instrument; describe the categories and corresponding prompts on the instrument; and illustrate how the instrument is used to evaluate the quality of well-known counting books commonly used in elementary mathematics classrooms.

Given the inconsistent quality of early counting books on the market, it is vital that teachers become critical consumers of the literature utilized for teaching elementary mathematics. As such, developing a research-based instrument that has been tested and validated is an important initial step for providing teachers with a user-friendly resource for critiquing children's books.

Key words: Elementary teacher education, early counting, numeracy – literacy connections, children's literature

Introduction

Pre-service teachers will teach in ways they experienced as students unless their assumptions are overtly challenged (Lortie, 1975) or they experience alternative teaching strategies from a learners' perspective. As such, we cannot expect teachers to know how to teach math differently if they have not experienced learning it differently. This is particularly important for pre-service elementary mathematics teachers who may lack sufficient content knowledge and suffer from high levels of mathematics anxiety; thus, not recognize the

important mathematical understandings their students are discovering. In an effort to address these issues, I engage elementary pre-service teachers through introducing and integrating children's literature in my *Mathematics Curriculum Methods* course.

Although current research supports the integration of high-quality children's books to teach mathematics; there exists no comprehensive instrument to guide elementary teachers' evaluation of children's books. As a result, I created two instruments to encourage reflection and challenge teachers to think more critically about the children's books they are sharing. For the purposes of this paper, I present one of the two instruments, specifically, the instrument focused on engaging young learners as they explore early counting concepts.

This paper will describe the development of the instruments beginning with an overview of the current literature related to this topic, and then outlining themes to emerge from the literature review which formed the foundation for the instrument. The paper then describes the specific components the instrument as they emerged from the review of the literature. The paper concludes with examples of how the instrument is used to evaluate the quality of well-known counting books commonly used in elementary mathematics classrooms.

Theoretical Framework

Since the *Curriculum and Evaluation Standards for School Mathematics* (National Council for Teachers of Mathematics (NCTM), 1989) advocated integrating children's literature and mathematics, numerous teacher resource books and annotated bibliographies have been published on this topic (Burns, 1992; Thiessen, 2004; Thiessen, Matthias, & Smith, 1998; Ward, 2009, 2007; Whitin & Whitin, 2004), as well various professional and academic journals have included articles attesting to the value of this integration in elementary (Duocolon, 2000; Seray-Moyer, 2000; Shih & Giorgis, 2004) and middle school (Draper, 2002; Zambo, 2005). As such, fourteen years after the publication of the *Standards*, educators generally agree that high-quality children's literature can provide a real-world context for exploring mathematics (NCTM, 2000; Shih & Giorgis, 2004; Young, 2001), nurture more positive mathematics dispositions (Mink & Fraser, 2006; Whitin & Whitin, 2004), and offer teaching strategies that encourage problem solving, reasoning and communication (Duocolon, 2000; Hellwig, Monroe & Jacobs, 2000; Moyer, 2000; Roth-McDuffie & Young, 2003).

Although research highlights the potential benefits of integrating literature as a strategy for teaching mathematics; the benefits can only be realized if the quality of the books utilized is sufficiently high. Yet, most teacher resource books and published journal articles focus on *how to use* children's books to teach mathematics rather than *how to assess the quality* of these books. Regrettably, many popular early counting books are of questionable quality and some are, essentially advertisements for popular candies, such as *The Gummy Candy Counting Book* (Hutchings & Hutchings, 1997) or *The M&M Counting Book* (McGrath, 1994). Moreover, some authors of early counting books have published series of books focused the same mathematics concept, such as the series of *Five Little Monkeys* books (Christelow, 1989, 1999, 2000, 2004).

Consequently, given the inconstant quality of available literature, it is vital that teachers become critical consumers of the children's books available for teaching mathematics. To do so, teachers need to review and critically examine math related children's books with consideration for both the literacy and numeracy quality. Moreover it is essential that teachers provide opportunities for young children to develop an awareness of numbers that goes beyond basic counting and number recognition. We need to provide children with

opportunities to explore numbers, see them in different contexts, and relate to them beyond the classroom. Children's literature can provide the venue for such explorations.

Methodology

The *Early Counting* instrument evolved over the eleven years I have taught Mathematics Curriculum Methods in a Bachelor of Education program. During this time, pre-service teachers were required to create a mathematics lesson plan that integrated children's literature. To support my students, I developed a database of approximately 1000 books that could be used in elementary math classrooms, as well as an online resource for sharing math – literature lesson plans (<http://education.uoit.ca/words2numbers/>). In spite of my efforts, many pre-service teachers created lesson plans based on poor-quality children's books. As such, I developed a framework for selecting high-quality early counting picture books. The *Early Counting* instrument was developed over time, founded on numerous literature sources and validated by multiple users, including: Mathematics and Language Arts Faculty of Education members, education librarians, math consultants, local K-8 mathematics teachers, and pre-service elementary teacher candidates.

The foundation for the instrument evolved from three specific sources: (i) grade level curriculum expectations from the *Ontario Mathematics Curriculum, Grades 1-8* (Ontario Ministry of Education, 2005); (ii) research specific to the conceptual development of early number sense, including instructional strategies that best support this development (Cain & Faulkner, 2012; Clements, 1999; Clements & Sarama, 2009; Kilpatrick, Swafford & Findell, 2001; Small, McDougall, Ross & Ben Jaafar, 2006; Small, 2005) and (iii) previously developed criteria used for assessing the quality of children's literature books (Halsey, 2005; Hefflin & Barksdale-Ladd, 2001; Hellwig, Monroe & Jacobs, 2000; Hunsader, 2004; Schiro, 1997).

Results

Conceptual development of early number sense

Research specific to the conceptual development of early number sense is extensive, has evolved over time and is grounded in the formative work of Piaget (1968) and Mehler and Bever (1967). For the purposes of this paper, I have summarized the fundamental tenets to emerge from the research that guided the development of the *Early Counting* instrument. Specifically, research asserts that to engage children in developing their number sense, counting activities should be situated in a meaningful, everyday context; provide opportunities to begin counting from different starting points, including counting backwards; and each count should be associated with a symbol and/or a quantity.

In addition to these tenets, the categories and corresponding prompts on the *Early Counting* instrument integrate essential counting principles which characterize conceptual understanding of quantity beyond recitation of a number sequence. Specifically, high-quality early counting picture book should include opportunities for children to explore the following counting principles:

- *Conservation of number* (i.e., the number of objects in a group stays the same regardless of whether they are spread out or close together);
- *One-to-one correspondence* (i.e., each object counted must be given one count and only one count);
- *Abstraction* (i.e., the size of the object counted does not change the quantity);
- *Cardinality* (i.e., the last number counted in a group represents the quantity of objects in that group);

- *Movement is magnitude* (i.e., as you move up the counting sequence, the quantity increases and as you move down or backwards, the quantity decreases); and
- *Subitizing* (i.e., instantly recognizing the quantity of a small set based on its pattern arrangement, as in the dots on a dice).

Previously developed evaluation criteria

Despite of an extensive review of the literature, I was unable to locate research specific to assessing the quality of early counting books. Moreover, research specific to assessing the quality of math – literature books is scarce (Hellwig, Monroe & Jacobs, 2000; Whitin & Whitin, 2004; Schiro, 1997), largely grounded on adopting the criteria previously established by Schiro (1997) (Halsey, 2005; Hunsader, 2004), or of poor quality, unsupported by research (Grover, Monroe & Jacobs, 2007).

Although the *Early Counting* instrument is unique, I integrated aspects of three previously established instruments as the foundation for this instrument’s framework: Schiro (1997), and Hunsader (2007) and Hellwig et al. (2000). More specifically, I adopted components of Schiro’s instrument, as the 11 criteria consider both literacy and numeracy quality. For example, Schiro’s evaluation the mathematics quality includes, but is not limited to, consideration for accuracy, effectiveness of the presentation, developmental appropriateness, integration of the mathematics in the storyline, and involvement of the reader. I also considered the evaluation instrument developed by Hellwig et al. as a foundation resource. This abbreviated instrument included five evaluation criteria: accuracy, visual and verbal appeal, connections, audience, and the ‘wow’ factor. Finally, Hunsader’s instrument is an abridged version of Schiro’s instrument which includes six of the eleven original mathematics criteria. This instrument provided the impetus for creating the Likert scale on the *Early Counting* instrument. The Likert scale, although largely subjective, provides teachers with a means to compare two or more books against a standardized set of criteria.

The current research served as the framework for the development of the *Early Counting* instrument and contributed to the three sub-categories on the instrument: *Early Counting Criteria*, *Illustration of Counting Objects* and *General Appeal*. Each of the three sub-categories is outlined in the subsequent section with specific reference to how the instrument is used to evaluate the quality of two early counting books commonly used in elementary mathematics classrooms.

Discussion

If teachers are to integrate high-quality children’s counting books into their teaching practice, they need to develop skills for assessing and selecting appropriate literature. Given the limitations of teachers’ time, the *Early Counting* instrument is purposefully brief with thirteen prompts subdivided into three broad evaluation categories: *Early Counting Criteria*, *Illustration of Counting Objects* and *General Appeal* (Table 1).

Early Counting Criteria:
The book explores counting beyond 1 to 10.
The book includes multiple representations of quantity, including: numerals, words, and illustrations.
The book includes opportunities to count forward and backward.
The counting concepts can be adopted for a range of abilities.
The book explores zero as a null set or as a multiplier (e.g. skip counting by ten)

Illustration of Counting Objects:
The objects are not crowded or partially illustrated.
The objects are clearly distinguished from the background.
The objects are illustrated in groups to encourage counting in sets, skip counting or subitizing.
General Appeal:
The book invites problem solving, communication or exploration
The book invites integration with other subjects and/or real-life situation
I want to re-read the book. It has <i>Wow Factor</i> .
The book is inclusive and devoid of stereotypes (e.g., gender, cultural).
The book engages young readers.

Table 1. Criteria for evaluating early counting picture books.

Upon completing the checklist, the reviewers are prompted to consider their responses within each category based on the following questions: Does the book have merit based on the *Early Counting* criteria? Does the book have merit based on the *Illustrations* criteria? Does the book have sufficient *General Appeal*?

Sample Evaluation: *Five Little Monkeys Jumping on the Bed*

Five Little Monkeys Jumping on the Bed (Christelow, 1989) is a commonly used early counting book and is a familiar chant often heard in Pre-school and Kindergarten classrooms. Although this book, and the three others in this series, regularly find their way into mathematics lessons; based on the *Early Counting* criteria, it is not an appropriate choice. Specifically, the book does not provide any opportunity for exploring four of the five *Early Counting Criteria*. Moreover, it provides only limited opportunities “to count backward” (i.e., from five to one). By contrast, the book has some merit based on the *Illustration of Counting Objects* sub-category. In particular, the counting objects (i.e., monkeys), in general, are not crowded on the page, are clearly visible and distinguished from the background. However, the objects are not illustrated to encourage counting of sets or subitizing. Finally, although I would score this book low on all criteria in the *General Appeal* sub-category, except “devoid of any stereotypes”; other elementary teachers may disagree based on the popularity of the book series. More specifically, because the book series is widely recognized by students, it may “engage young readers” and the teacher may frequently “re-read the book”. Moreover, although the story offers limited opportunities for problem solving; many children understand the appeal of jumping on the bed, as such the book integrates “with real-world situations”.

Sample Evaluation: *Ten Flashing Fireflies*

Although *Ten Flashing Fireflies* (Sturges, 1999) is not a commonly used early counting book; it is a high-quality book with strong merit in all three sub-categories of the *Early Counting* instrument. This beautifully illustrated book flawlessly integrates mathematics with the storyline while providing multiple opportunities for students to explore number quantities and develop their sense of part-whole relationships. Although the book does not explore “counting beyond 10”; it addresses all remaining criteria in each sub-category. Of particular significance is the simultaneous illustration and exploration of counting forward, counting backward and representing part-whole relationships. These concepts are introduced and illustrated as the reader follows the adventures of a young boy and girl as they explore the night catching fireflies. With each turn of a page the book illustrates ten fireflies, some in a jar and the remainder in the night sky. Consequently, the story provides multiple

opportunities for exploring, the conservation of number, subitizing and part-whole relationships (i.e., $8+2 = 7+3 = 10$). However, the book extends these mathematical relationships by consistently illustrating the increasing number of fireflies in the jar on the facing page of the book (i.e., illustrating counting up to 10); while simultaneously illustrating the decreasing number of fireflies in the sky on the opposite page (i.e., illustrating counting down from 10 to 0). This pattern is reinforced by the rhyming text. The story begins,

What do we see in the summer night? Ten flashing fireflies burning bright!

Catch the one twinkling there. Like a star.

Continuing on the next facing page (one firefly illustrated in the jar),

One flashing firefly in our jar.

With the opposite page (nine flying fireflies illustrated)

What do we see in the summer night? Nine flashing fireflies burning bright!

Capture another one. Now there are ...

Beyond the strengths of the book specific to the sub-categories of *Early Counting Criteria* and the *Illustration of Counting Objects*, it is not surprising that the book also has strong merit in the *General Appeal* sub-category. In particular, the book's beautiful illustrations and predictive rhyming text "engage young readers" and encourage them to read aloud with the teacher. Given the integration of multiple early counting principles, this book "invites problem solving, communication and exploration". This is a book with *Wow Factor* that summonses students and teachers to repeatedly read it, for both the quality of the mathematics and the quality of the literature.

Conclusions

A high-quality math-literature book should also be a high-quality children's literature book. Although selecting and using quality literature to teach Language Arts is common practice for most elementary teachers; these skills do not seem to transfer to the selection and use of quality mathematics literature.

We cannot expect teachers to know how to integrate literature into their mathematics practice unless they are provided with opportunities to explore this as a viable teaching strategy. It is for this reason that teacher educators and professional development providers should engage pre-service and in-service elementary teachers as mathematical problem solvers by integrating literature into coursework and professional development activities. Beyond modeling the math – literature connection, of equal importance is supporting the development of teachers' appraisal skills for assessing and selecting appropriate children's literature. In order to do so, teachers require time and opportunities to select, read, and analyze children's literature for teaching mathematics. The *Early Counting* instrument is one tool that can be used to guide teachers' critiques of the children's books and stimulate critical reflection. Through repeated exposure to varying qualities of literature and considering the characteristics of high-quality literature, teachers become more critical, well-informed consumers of children's literature for teaching mathematics.

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