J Math Teacher Educ (2012) 15:429–452
DOI 10.1007/s10857-012-9220-5

Prospective elementary teachers' perceptions of real-life connections reflected in posing and evaluating story problems

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Published online: 5 June 2012
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Abstract This study explored prospective elementary teachers' perspectives on real-life connections in the case of story problems. A series of tasks were designed to uncover the participants' collective perceptions of real-life connections by speculating on participants' emerging beliefs about real-life connections and how their beliefs were reflected in the story problems they posed or evaluated. Findings revealed the following ideas: (a) there were overly positive beliefs with insufficient specifics; (b) participants perceived utility and reality as critical components of real-life connections; and (c) there were vast discrepancies between their beliefs and the way they posed or evaluated story problems for real-life connections. These results will generate further discussions about the issues and challenges teacher education programs face, while providing suggestions for future research.

Keywords Real-life connections · Story problems · Prospective teachers · Teacher thinking

High-quality mathematics instruction at all levels can be defined in many different ways, representing various facets of the teaching and learning of mathematics. Although it is hard to characterize good mathematics instruction in a few words, there are some features of good instruction which are frequently referred to, such as teaching for higher-order thinking, critical thinking, or teaching that promotes students' active engagement. While these are good components of quality teaching, it is uncertain whether there is a consensus on the meanings of these characteristics and how much consistency exists between what people believe and what they actually do in practice. For instance, Thompson's (2008) study on mathematics teachers' interpretation of higher-order thinking in Bloom's taxonomy found that the high school mathematics teacher participants had varied definitions of higher-order thinking. Thompson's study also indicated that the mathematics teachers were often able to identify various characteristics of higher-order thinking; however, many of them did not write higher-order thinking assessment items. Several studies also

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addressed that what teachers claimed about implementing standard-based or reform-oriented instruction via self-reported survey was not completely consistent with their actual teaching practice (e.g., Mayer 1999; Spillane and Zeuli 1999).

This study focused on one such generally assumed characteristic of high-quality mathematics instruction, real-life connections. The idea of real-life connections is widespread, and curriculum documents in many countries explicitly support the benefits of connecting school mathematics with students' daily lives (e.g., Brenner and Moschkovich 2002; Verschaffel et al. 2000). In case of the United States, as one of the process standards and guiding principles for curriculum and assessment, the National Council of Teachers of Mathematics (2000, 2009) has continuously emphasized the importance of connections with other subject areas and disciplines as well as to students' daily lives.

The mathematics education literature locates a range of practices under the umbrella of real-world connections, including the following:

- simple analogies (e.g., relating negative numbers to subzero temperatures)
- classic "word problems" (e.g., "Two trains leave the same station…")
- the analysis of real data (e.g., finding the mean and median heights of classmates)
- discussions of mathematics in a society (e.g., media misuses of statistics to sway public opinion)
- hands-on representations of mathematics concepts (e.g., models of regular solids, dice)
- mathematically modeling real phenomena (e.g., writing a formula to express temperature as an approximate function of the day of the year) (Gainsburg 2008, p. 200)

Within these practices, 'word' or 'story' problems, which present the problem context as text or a narrative of some sort, might be the most frequently used format, as it has appeared in many mathematics curriculum materials and in actual teaching practices around the world. In a broad sense, story problems refer to questions presented as narrative forms containing more or less realistic contexts as opposed to questions presented as pure mathematical notations. In this study, story problem is being interpreted based on this view of it. In particular, this study examines prospective teachers' perspective of real-world connections through their posing of such story problems. This assumes a view of a direct relationship between story problems and reality as supported by the literature.

Ideally, story problems are believed to be a vehicle to represent the "interplay between mathematics and reality and give a basic experience in mathematizing" (Sowder 1989, p. 48). It is expected that story problems serve "as the link between the two faces of mathematics, namely, its grounding in aspects of reality and the development of abstract formal structure" (Greer 1997, p. 300) by providing students with an opportunity "to translate a real situation into mathematical terms" and "to experience that mathematical concepts may be related to realities" (Polya 1962, p. 59). A major goal of linking reality and mathematics in this way is the fostering of mathematical literacy. Just like memorizing the spelling of words and reciting definitions of the words alone cannot be defined as literacy, simply knowing the symbolic and abstract nature of mathematics cannot be defined as mathematical literacy. In this sense, story problems can offer the opportunity to develop mathematical literacy by encouraging the learner to adequately understand and apply mathematics concepts in both the real and abstract worlds. However, unlike this clear role at the theoretical level, researchers have raised many concerns and questions about the actual implementation of word problems in the classroom, which have generated further discussion. Such discussions include the types and structures of story problems contained in the curriculum materials, teachers' and students' beliefs and conceptions about real-life-connected story problems and their ability to solve those problems, influence of sociological variables (e.g., socioeconomic status or gender) on students' responses to such problems, and the ultimate effectiveness of story problems for improving mathematics instruction and student achievement (e.g., Boaler 1994; Carraher and Schliemann 2002; Chapman 2006a, b; Contreras 2002; Cooper and Dunne 2000; Verschaffel et al. 1997). Of particular importance to this study is the issue of what teachers know about real-life-connected story problems that could impact what they implement as real-life connections in their teaching of mathematics. Considering the significant impact of teachers' knowledge and beliefs on their interpretation and implementation of curricula and daily teaching practices (e.g., Barlow and Reddish 2006; Cooney and Wiegel 2003; Thompson 1992), it is an important first step to probe practicing or prospective teachers' perceptions of story problems with respect to their role in the "interplay between mathematics and reality" (Sowder 1989, p. 48).

The purpose of this study, then, was to explore prospective elementary teachers' perspectives of real-life connections in mathematics instruction through a series of tasks that involved posing story problems. The intent was to evaluate the quality of the story problems they posed for real-life connections in order to gain insights into their perceptions and understanding of what constitutes real-life connections in the teaching and learning of mathematics. The outcome has implications for teacher education and future research in addressing this important aspect of mathematics teachers' knowledge.

Related literature

This section expands the preceding literature review to address studies associated with real-world connections in mathematics education, teacher education, and teacher practice. In particular, it discusses issues raised that are relevant to framing this study. Three areas highlighted are the meaning and use of real-life connections, the use of real-life connections in actual practice, and studies on prospective teachers in this area.

Meaning and use of real-life connections

As aforementioned, it is widely accepted that story problems serve as the link between mathematics and the real world. In fact, the idea of real-life connections is extensively referred to within educational communities as a way of supporting students' learning and is highly recommended in many curriculum documents relating to mathematics education. Many research studies have resonated the promising results of focusing on the experiences of the learner's everyday life, underscoring the benefits of real-life connections such as students' understanding of mathematics concepts, motivational support for learners, and its usefulness in students' current and future lives (e.g., Boaler 1993; De Lange 1996; Streefland 1993). However, many researchers have pointed to ongoing issues involving the meaning of everyday (real-life) mathematics, the relationship between everyday (real-life) mathematics and academic mathematics, and the impact of everyday (real-life) practices on classroom instruction (e.g., Brenner and Moschkovich 2002). The report from the National Mathematics Advisory Panel (2008) in the United States also addressed the lack of consistency of the use of the term "real-life" problem in research and practice. The panel stated:

> The meaning of the term "real-life" problem varies by mathematician, researcher, developer, and teacher. …. [M]ost likely, although not addressed in the studies examined by the Panel, teachers' knowledge and capacity to use such problems effectively varies greatly. (p.49)

While these issues regarding the nature and classroom use of real-life problems are important, addressing them in further detail is beyond the scope of this study. For this study, theoretically, "real life" is being associated with the participants' real or imagined experiences in relation to their everyday life outside of the context of formal classroom activities. However, since the focus is on the participants' perspective of real-life connections, their story problems can involve contexts based on what they perceive to be real-life connections and are not restricted to a prescribed view of it. Thus, their story problems could reflect any of the five practices associated with real-life connections as noted earlier in the introduction of this article.

Real-life connections in actual practice

With respect to actual classroom implementation, as already suggested, the use of real-life problems could be problematic. However, there are conflicting findings, depending on the source of the evidence by a few relevant studies that indicate that real-life connections are, or are not, frequently happening in actual mathematics classrooms. For example, the TIMSS 1999 Video Study conducted by Hiebert et al. (2003) reported that most of the countries studied demonstrated low amounts (9–27 %) of real-life-connected problems in their curriculum materials, with the exception of the Netherlands (42 %). Mathematics teaching in the Netherlands strongly reflects the principles of Realistic Mathematics Education (RME). In RME, "reality" is conceived as a source for learning mathematics as well as a tool for application (van den Heuvel-Panhuizen and Wijers 2005). Thus, the high amount of real-life-connected problems in the Dutch curriculum materials appeared to be consistent with the principles of RME in the Netherlands. However, Mosvold's (2008) study provided an interesting point to this cross-national comparison. In the TIMSS 1999 Video Study, only 9 % of Japanese lessons had real-life connections whereas 42 % of Dutch lessons were set up using real-life connections. Using the TIMSS 1999 Video Study materials, Mosvold (2008) compared the cases of Japan and the Netherlands in terms of real-life connections in actual implementation and reported that Japanese teachers follow the ideas and principles of real-life connections to a stronger degree than Dutch teachers. This implies that the amount of real-life connections in the curriculum is not necessarily reflected in the quality of real-life connections in the actual teaching practice.

These studies suggest that excluding the teachers as important factors in determining the use of real-life connections in the classroom could lead to incomplete understanding of the situation. But the implication that is important to this study is that how the curriculum gets interpreted by teachers will depend on their understanding of real-life connections and ability to select or create appropriate real-life mathematics problems to support and extend the curriculum. Thus, investigating prospective teachers' perspective of such connections by having them pose such problems is important to understand the knowledge they hold that could influence their interpretation of the curriculum and what they do in their teaching.

Studies of teachers and real-life connection

Ever since the 1960s, there has been extensive research on students' difficulties in solving story problems in a realistic manner (see Verschaffel et al. 2000, for a detailed review). Unlike abundant research studies on students' performance, previous research on prospective teachers' (or practicing teachers') conceptions about real-life connections is scarce. Moreover, most of the studies focused on the teachers in problem solvers' roles. As Chapman (2006a) explained, there has been little attention given explicitly to the teaching of word problems and, in particular, no focus on how context is dealt with from the perspective of the teacher or the classroom.

In the context of the problem solver, research indicates that there was a strong resistant tendency among prospective teachers to exclude real-world knowledge from their own spontaneous solutions of arithmetic word problems, as well as from their appreciation of students' answers (Verschaffel et al. 1997). It is also reported that prospective elementary teachers did not always base their responses on realistic considerations of the context situation (Contreras 2002). The challenges and issues regarding prospective teachers' performance as problem solvers, as reported in the above studies, are not much different from results in other studies that investigate primary or secondary students' problem-solving performance (e.g., Greer 1993; Shoenfeld 1991; Verschaffel et al. 1994).

In the context of practice, in an effort to probe teachers' conception and classroom use of story problems, relatively recent studies utilized classroom teaching observations and interviews as data and analyzed the data adopting Bruner's (1985) notion of narrative and paradigmatic modes of thought. In relation to story problems, Chapman (2006a) and Depaepe et al. (2010) describe paradigmatic knowing as the perspective that focuses on mathematical models or mathematical structures that are universal and context-free. On the other hand, narrative knowing is described as the perspective that deals with the social context of the problem, focusing on "the cover story of the word problem in order to understand or relate to the storyline, plot, characters, objects, situations, actions, relationships, and/or intentions" (Chapman 2006a, p. 216). Chapman's (2006a) study of 14 experienced teachers at various grade levels revealed that the paradigmatic mode was more dominant and was combined with the narrative mode in different ways. Depaepe et al.'s (2010) study of seven-month-long video-based observations in two regular sixth-grade mathematics classrooms reports that teachers' teaching of story problems was dominated more by a paradigmatic than a narrative approach and that a strong focus on a paradigmatic approach does not exclude a strong narrative approach and vice versa. Researchers of these studies recognized that the distinction of these two perspectives should be understood as a spectrum, not a dichotomy. However, this focus on teachers' perspectives toward story problems helps to reveal teacher thinking and provide further support of its possible nature.

These studies imply that there are issues in how teachers deal with real-life connections in solving story problems and teaching problem solving through story problems. These issues have implications for how teachers engage students in problem solving or real-life problems. In addition, as Depaepe et al. (2010) suggest, the stereotyped and unrealistic nature of the problems used in classrooms and the way in which the problems are conceived and treated by teachers are plausible reasons for students' difficulties in solving story problems. These conclusions further support the importance of the present study to investigate prospective teachers' perceptions about real-life-connected story problems from multiple perspectives. Noting that teachers' conceptions and the way they treat such problems is one of the likely causes of students' difficulties, there is a clear need to study teachers' perspectives in depth to gain insights into how to support their learning in order to improve teaching. For example, as Chapman (2006b) proposed based on her study, learning opportunities for prospective teachers should include not only how to solve problems, but also how to analyze, represent, and compare story problems. This study adds another dimension in focusing on problem posing of real-life-connected story problems.

In general, the preceding three categories of this literature review suggest that there is a need to further investigate practicing or prospective teachers' perspectives about story problems, not just focusing on their views as problem solvers but as problem posers. The study described in this article attempts to address this need by exploring how prospective teachers acknowledge and interpret the role of real-life-connected story problems via a series of tasks that emphasize their roles as problem posers and evaluators rather than problem solvers. Thus, it is expected that the approach in this study can elicit more active views from future teachers beyond their personal preference of problem solving as learners.

Research method

Research questions

Specifically, this study examined the following questions:

1. What types of story problems do prospective teachers pose as exemplary representation of real-life connections? Are there dominant themes in terms of the contexts used and mathematics concepts targeted?
2. Which characteristics do prospective teachers associate with quality real-life-connected story problems in posing or evaluating story problems?
3. Are there any discrepancies noted between the prospective teachers' perceived features of real-life connections and the story problems they posed or evaluated?

Participants

The participants for the study were 71 undergraduate teacher candidates enrolled in three sections of a K−8 mathematics methods course in a Midwestern university in the United States. The author was the instructor for all three sections. All participants were elementary education majors. This sample is a fair representation of the larger population of elementary education majors at the university. Participants had successfully completed mathematics content courses prior to this methods course. For most of the participants, it was the last semester prior to beginning their one-semester student teaching. The participants were predominantly white (87 %) and female (89 %). Approximately 67 % of the participants were non-traditional students in the sense that there was a gap of time between their enrollment in college and graduation from high school.

Context

Real-life connection was addressed in class as a part of current national and state curriculum documents. In the beginning of the course (Class 1), the principles and standards by National Council of Teachers of Mathematics (2000) were briefly overviewed. While examining process standards, the idea of connections was introduced. The instructor purposefully avoided putting special emphasis on the connection standard. It was treated as a part of the current national curriculum document just like other principles and standards. Additionally, the course instructor tried not to impose particular interpretations, purposes, or directions for real-life connections throughout the semester. The participants engaged in a series of tasks by proposing criteria for good real-life-connected story problems and posing and evaluating sample story problems (see the descriptions of tasks in the following section). All of these tasks were course assignments that were graded for completion and they were spread out throughout the semester.

There was a reason for purposefully limiting the instructor's input. It grew from the instructor's interest in making explicit elementary teacher candidates' stance on teaching and learning mathematics in general and its embodiment in more specific contexts. Through personal teaching experience, the author noted that many teacher candidates already brought a strong conviction to this class that the idea of real-life connections would be a beneficial instructional strategy in teaching mathematics and other subjects, as frequently referenced in their written or verbal accounts of good instruction. However, it was uncertain whether these teacher candidates' opinions were internalized thoughts or mere reiteration of what they kept hearing from external authority figures; moreover, the kind of contexts the participants envisioned when they mentioned the term "real-life connections" and whether there was common ground among the participants' opinions were unclear and lacking. With these thoughts in mind, a series of tasks were designed to uncover the participants' perceptions about real-life connections via their problem-posing and problem-evaluating activities.

Tasks and data collection

The data were collected from a two-part written course assignment that was completed outside of class time. Early in the semester, as the first part of the assignment, participants were asked to provide at least three criteria for exemplary story problems for real-life connection. In addition, this part of the assignment had the participants collect two story problems and create two story problems that *best* represent real-life connections, in their opinions, based on their criteria. There was no restriction in terms of the grade level and content areas.

For the second part of the assignment, the investigator (instructor) and a research assistant reviewed all story problems posed by the participants and selected 10 examples representing different types of questions in terms of the format, contexts, lengths, and complexity. Then, a short questionnaire was administered at the end of the semester. Participants first rated each example on a 5-point scale, 5 representing the highest quality of real-life connections. Next, the participants commented on the strengths and weaknesses of each example. Finally, two short questions drawn from the results of participants' story problem creations were asked (see "Appendix" for the post-questionnaire).

The investigator believed that a series of tasks—thinking of necessary criteria, posing problems, and evaluating problems—would be more effective for eliciting participants' perspectives about the role and use of story problems for real-life connections than just asking them what beliefs about real-life connections they had in an abstract manner. Participants' written criteria for real-life-connected story problems, collected and posed story problems by the participants, and the numeric ratings and comments on the 10 sample story problems were collected as data.

Data analysis

The data were analyzed via two levels. The first level of analysis provided descriptive information to provide an overall picture of participants' perceptions. Those included the frequencies of the targeted concepts, the context utilized, and the mean scores of the numeric ratings on the 10 sample story problems. The second level of analysis followed some aspects of open-ended coding and a double-coding procedure (Miles and Huberman 1994; Strauss and Corbin 1998) of the participants' responses in text (e.g., criteria of real-life-connected story problems and justifications for their evaluation of sample story problems for real-life connections). For the criteria, all entries were analyzed for coding. For the justifications, including both strengths and weaknesses of the problems, participants' responses on two highly rated examples and two low-rated examples were analyzed in depth to get a snapshot of this group of participants' thoughts on the quality of real-life-connected story problems.

Initially, the investigator and the research assistant independently reviewed the criteria and justifications proposed by participants to identify recurring themes and intentions. Later, the investigator and the research assistant jointly revised and refined the independently identified themes through comparison and discussion. Once the themes for coding were identified, the investigator and the research assistant independently coded a random sample of 10 participants' data, and the concordance between two coders was 82 %. For the rest of the data, the investigator and the research assistant jointly coded so that the discussion on coding discrepancies could be resolved immediately. At the completion of coding, frequencies of coded themes were identified. In the results section, selected excerpts and examples of posed problems were used to illustrate the common themes identified. This study adopted an exploratory character offering plausible explanations for further investigation in mathematics teacher education, rather than providing conclusive evidence regarding the quality of prospective teachers' understanding or performance (Yin 2009).

Results

This section presents the findings under the following topics: (a) features of collected story problems; (b) features of posed story problems; (c) analysis of aspects considered in collecting and posing story problems; (d) analysis of justifications for rating sample story problems; and (e) analysis of post-survey.

Features of collected story problems

Participants were asked to collect two exemplary real-life-connected story problems. The participants collected a total of 142 story problems from various sources. Participants indicated the sources for collection along with the actual story problems.

Sources of collection

About 37 % of collected story problems were taken from printed sources. Those included textbooks or supplementary materials used in the participants' field settings (38 problems), textbooks used in the university courses (12 problems), and mathematics education literature (3 problems). The rest of problems (about 63 %) were collected via various web-based resources. Those included lesson plan sites (27 problems), mathematics activity sites (52 problems), and web resources provided by university, school district, or professional organizations (20 problems).

Targeted contents/concepts

The predominant content covered in the collected story problems was the application of proper operations to get a numerical answer. Geometry and measurement contents were also included in conjunction with number operations in some story problems (e.g., "A 240 kg bag of birdseed is priced at $16.88. If 75 g of this feed is put in a bird feeder each day, how many days will it be before the bag of seed is empty? How much does it cost to feed the birds each day?," a story problem taken from Bennett and Nelson's (2000) textbook). Only a limited number of problems (about 8 %) covered other content areas without placing too much emphasis on the computational process (e.g., probability of forming different committees, investigating nets for a cube, creating a graph).

Contexts utilized

While the money or time-related contexts were dominant (about 35 %), a variety of situations were used. The following are some examples of such situations: road construction, options of presents, election, packing, grouping, sporting events, well-known stories (e.g., using the "Three Little Pigs" story plot).

Features of posed story problems

Each participant created two real-life-connected story problems. A total of 142 story problems were analyzed from several different perspectives such as targeted concepts and the contexts or situations they utilized in their problems,

Targeted contents/concepts

The majority of the story problems the participants posed were focused on numbers, operations, and computational skills within the context of other content areas such as geometry and measurement (i.e., geometry and measurement contexts were used, but the main process of problem solving was calculating given numeric value to get the answer). Less than 2 % of problems dealt with data analysis, probability, and geometry as targeted contents. This result is similar to what the participants demonstrated in their collected problems.

Contexts utilized

About 50 % of the total problems utilized time or money-related contexts. About 32 % of problems incorporated money-related contexts (e.g., buying goods, selling things, paying bills, travel budget, salary, allowance), and 18 % of problems utilized time-related contexts primarily focused on finding the elapsed time. The other less frequently used contexts included cooking/recipes and eating/sharing food situations. Compared to the collected story problems, there was a lack of variety in contexts chosen in the problems created by the participants; however, the results were similar in that money or time-related situations were most frequently used.

Analysis of aspects considered in collecting and posing story problems

A total of 223 brief statements described the aspects participants considered in selecting and posing exemplary real-life-connected mathematics problems. Table 1 shows the major themes found in participants' criteria statements.

It was noted that about 42 % of statements were not directly geared toward "real-life connectedness." Rather, those statements addressed what they considered *good* mathematics problems in very general terms. Such statements included the following aspects of story problems:

- Clear directions; easy to understand
- Age or grade level appropriate (e.g., met state standards)
- Appropriate challenge levels; involve high-order, critical thinking
- Utilize multiple modes of representation (e.g., drawings, charts)

Table 1 Themes in participants' criteria used in collecting and posing story problems

Major themes	Sub-themes	Number of entries (%)
General statement for quality problems		94 (42.15)
Contexts should be relatable to students	General statement	27 (12.10)
	For the purpose of utility (emphasis on the usefulness in daily life)	19 (8.52)
	For the purpose of reality (emphasis on the resemblances with the situation in daily life)	12 (5.38)
	For the purpose of enhancing math understanding	5 (2.24)
Potential for promoting motivation		26 (11.65)
Structure and format of the problem	Existence of excessive information just like real situations	3 (1.35)
	Straightforward information (no unnecessary information)	5 (2.24)
	Incorporating multiple concepts	3 (1.35)
	Incorporating dialogues (realistic conversations)	1 (0.45)
	Appropriate length of the problem	1 (0.45)
Hands-on activities in the actual situation		10 (4.48)
Level of readability	Appropriate length (no excessive lengths)	7 (3.14)
	Clear wording, terminology	3 (1.35)
Equity (consideration of diversity, cultural/gender biases)		7 (3.14)

The rest of the statements (58 %) merged into several categories as described below:

Contexts that can be relatable to students (N = 63)

Twenty-seven responses in this category simply stated that the context should be relatable to students without any indication of their definitions of "real-life connectedness." The other responses highlighted different purposes and formats for the connections. Nineteen responses emphasized the utility of the context. In other words, the contexts that accommodated the application of mathematics concepts to students' daily lives were considered a purpose of real-life connections. For example, a participant who created contexts for adding and subtracting money and calculation of elapsed time stated, "I feel that money and time are so important at a young age because we use them in our every day life. Students need to have a great understanding of it in order to function in society properly." Twelve responses addressed the reality of the context, portraying a situation students may encounter in their daily lives. This view is well addressed in one participant's statement: "Contexts that mirror students' own lives." Five participants stated that the purpose of real-life connections is for enhancing students' mathematical understandings. Examples include: "The question should help reinforce the topics that are being covered in class" and "Real-life connection will help students understand mathematics better."

Potential for promoting motivation (N = 26)

These responses addressed how real-life-connected story problems would enhance students' interest, motivation, and engagement. There were similarities in the responses, like the following example taken from one participant's statements: "I collected and created these math stories because I thought they were fun and interesting for my students to do."

Structure and format of given information (N = 13)

This category focused on what kind of information should be given and how it should be presented. Although 13 responses belong to this category, their main issues were different. For example, three statements specifically asserted that good real-life-connected story problems should have additional information or numbers that would not directly be used to solve the questions. One example stated, "Stories include unnecessary information to help students with their discretionary problem-solving skills in their daily lives." In contrast, five participants proposed to provide only the information that is needed to solve each question. Such statements declare, "All of the information to solve the problem must be given. No information should be left out" and "Only include information that is relevant—don't want to confuse students." Other statements suggested incorporating multiple concepts in the context, including dialogues, and shortening the question's length.

Hands-on activity as a process of problem solving (N = 10)

These statements referenced the need for contexts to require students to be involved in hands-on activities or the acting-out process in the actual situation as a criterion of quality real-life connections. One example stated, "The problem is something that students would really be required to engage in hands-on activities outside of the classroom in order to solve the question."

Readability (N = 10)

These responses specifically commented on the level of readability involved in the given text. All of them voiced concerns about the potential readability issues when creating real-life-related contexts. The major concern was the length of the text ($N = 7$). A participant stated, "Students should not be intimidated by excessive lengths." Another participant noted, "It should not test reading, but rather mathematics." Other responses ($N = 3$) addressed appropriate wording and clear terminology in the given text.

Equity (N = 7)

These responses focused on the potential bias that the problem context might have. In particular, these seven responses paid close attention to cultural and gender issues. Two examples are as follows: "I want to see diverse groups in the context" and "The context should not contain any cultural or gender bias."

Analysis of justifications for rating sample story problems

Table 2 shows the participants' average rating for each example. Participants' written descriptions of the strengths and weaknesses of two highly rated examples (Example #1 & Example #3) and two low-rated examples (Example #5 & Example #6) were analyzed in depth (see Table 3). To clarify participants' perspectives along with specific examples of statements, this part of the analysis is presented by the strengths and weaknesses of each example, not by the overall themes.

Table 2 Post-evaluation on sample story problems

Example number	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Average ratings	4.31	2.90	4.21	3.68	2.26	2.49	3.36	3.63	3.71	3.80

$N = 71$; A 5-point scale was used (5 representing the highest quality of real-life connection)

Table 3 Themes in justifications used in evaluating sample story problems

Example number	Major themes	Number of entries (%)
Example #1: strengths	Realistic situation for students (commonly happening situation)	68 (95.77)
	Grade appropriateness	1 (1.41)
	Well-worded text	2 (2.81)
	Total	71 (100)
Example #1: weaknesses	No flaw	17 (23.94)
	Level of reality (should more reflect the reality of students' lives)	25 (35.21)
	Unclear word choices/grammatical errors	14 (19.72)
	Level of difficulty	9 (12.68)
	Amount of information (unnecessary details)	6 (8.45)
	Total	71 (100)
Example #3: strengths	Realistic situation for students (commonly happening situation)	69 (97.18)
	Grade appropriateness/writing style	2 (2.82)
	Total	71 (100)
Example #3: weaknesses	No flaw	19 (26.76)
	Confusion due to unclear context of a terminology (maximum)	17 (23.94)
	Level of reality (unlikely situation)	13 (18.31)
	Grade-level appropriateness (the concept of remainder)	16 (22.53)
	False claim: interpret the interpretation of the remainder impossible in the real life	6 (8.45)
	Total	71 (100)
Example #5: strengths	Realistic situation for students (commonly happening situation)	60 (84.50)
	Promote organization & reasoning skills	9 (12.68)
	No strength	2 (2.81)
	Total	71 (100)
Example #5: weaknesses	Length and structure of the information	65 (91.55)
	Level of reality (unlikely situation)	6 (8.45)
	Total	71 (100)
Example #6: strengths	Quality as a math problem—not necessarily with respect to the real-life connection	59 (84.50)
	No strength	6 (8.45)
	Level of reality (act out as a detective)	5 (7.04)
	Total	70 (98.59)
Example #6: weaknesses	Level of reality	64 (90.14)
	Clarity of directions	4 (5.63)
	Grade appropriateness	3 (4.22)
	Total	71 (100)

Example #1: strengths

Example #1 is one of the typical word problems many participants created, asking for the application of one or more arithmetic operations with the given numbers. Except for three, all participants stated that the strength of this example was that most young students in their daily lives could encounter the realistic situation portrayed. The other three participants suggested that grade appropriateness and well-worded text were strengths of the example.

Example #1: shortcomings

About 24 % of participants stated that there were no flaws in terms of a real-life connection. Other participants provided more critical views on various aspects of the example. The major shortcoming addressed by participants was the level of reality. About 35 % of participants pointed out that the context should more accurately reflect the reality of students' lives. The following excerpts show participants' suggestions for creating more *real* contexts:

- It may have different interpretations. I am an athlete. We need to be there earlier than when the game actually started. Also, we need to consider the time for traffic, uniform changing, and warm-up.
- As in the real world, answers may vary (traffic, time to get to the car, etc.). I would ask students to explain.

About 20 % of participants had concerns over word choice or grammatical errors in the given text. Other responses noted the level of difficulty (13 %) and the amount of information provided (8 %) as shortcomings of this example. In terms of the level of difficulty, some participants judged that the question was too easy for the given grade level and others thought it was too complicated for second graders. Regarding the given information, participants claimed there were too many unnecessary details, such as the time the party ended and the name of the bowling alley.

Example #3: strengths

The strengths justified by participants for this example were very similar to the explanations provided for Example #1. The majority of responses valued the easily relatable context for students. Some minority opinions mentioned grade appropriateness and writing styles.

Example #3: shortcomings

Nearly 27 % of participants stated that there were no shortcomings in this example with respect to real-life connection. Twenty-four percent of participants asserted that this context was confusing because of the terminology "maximum". Some excerpts include the following:

- Answer depends on whether or not each table has to be full. In reality, not all of the tables will be full.
- No hint that there could be less than 22 students at one table or each table needs an equal amount of students.
- Maximum means that not all of the chairs are used at each table; Minimum should be used.
- It should clearly state that at each table, 22 students will be sitting—not maximum 22.

About 18 % of participants felt this context would be a highly unlikely situation in students' actual schools in several ways:

- 22 students cannot actually fit on one cafeteria table. Minimize the size of number to make it a little more actual.
- Usually this is not something that students will really worry about.
- Students are not likely to need to know how to divide up the lunchroom.
- Usually schools have more than one lunch period—not all students are eating at the same time.

About 22 % of participants mentioned the grade-level appropriateness as the weakness of this example. In particular, they considered that the concept of remainders, the size of numbers, and the term "maximum" made the question more difficult than the targeted grade-level ability. Six participants provided false claims stating that the context of the question is mathematically incorrect. Mostly, they failed to interpret the meaning of the remainder. Those statements are as follows:

- The answer is not a whole number and you cannot cut a table in half to represent a decimal.
- 4.636363…. In real life, you cannot have .63 of a table.
- We focus on exact math. This is not exact. What do you do with the extra 8 seats?

Example #5: strengths

A major strength in the text was the use of possible situations in students' daily lives (e.g., eating pizza, ordering pizza, figuring out the best deal, changing minds). About 13 % of participants stated that this question was good since it promotes students' data organization and reasoning skills.

Example #5: shortcomings

The biggest criticism about this example was the length and structure of the given text having overwhelming information and words (about 92 %). Participants also stated that the text, as written, distracted from its key point of teaching the main mathematics concepts. The next biggest concern was that several aspects of the text were not realistic (about 8 %). Those examples include:

- If I were in this situation, I would make a generous estimation and not mind having some pizza leftover.
- In real life, it is hard to know exact number of slices of each pizza they would like.
- Too many options. Normally, there would be one or two types of pizzas ordered.
- Kids don't order pizza.
- 4–5 slices of pizza are a lot for 3rd graders.

Example #6: strengths

About 9 % of participants stated that there were no strengths in the text, especially pertaining to real-world connections. A participant stated, "There is no real-life connection. The only real-life connection that students can make is the connection to their math class." About 7 % of participants considered that this question provided a real-life context by allowing students to act like a detective to find the solution using clues. The rest of the responses (84 %) addressed positive aspects of this example as a mathematics problem, not necessarily with respect to real-life connections. Those responses included visual representation (e.g., chart, table) and clear concepts being assessed.

Example #6: shortcomings

More than 90 % of responses stated that this example has nothing to do with a real-life scenario suggesting that it should "include some action with people in the context so students can imagine whatis going on in their minds" or "include cues how this will be useful in life or how to apply them to real-world." Some statements recommended specific changes. For example, one participant suggested adding the following statement to the beginning to make a more realistic situation: "Sarah's mom is trying to help her figure out how many people are in their town. Can you help her by using these clues?" Other minority opinions addressed issues other than real-life connectedness, such as grade-level appropriateness or clarity of directions.

Analysis of post-survey

The post-survey consisted of the following two questions: (a) whether real-life connections are more appropriate for specific topics and (b) whether participants can think of any word problems that have no real-life-connected contexts. These questions were added to clarify several of the participants' points of view that vaguely appeared in their previous responses.

Topics

About 47 % believed that almost all mathematics concepts could be connected to something in the real-world. One participant stated, "It is for any and all math concepts. If there is a math concept we cannot relate to real-world, why do we need to learn it?" The remaining 53 % replied that there exist more appropriate concepts for real-life connection. As addressed in the question, time and money are appropriate because they are the concepts students are familiar with and use, making them utilitarian to a student's life. Also, for the same reason, some participants stated that these are easy concepts to pose textual problems from the teacher's perspective as well.

Possibility of no real-life-connected story problem

About 56 % of participants stated that it is nearly impossible to create story problems without using real-life contexts. The following three statements represent three popular justifications:

- Math is just part of our life. We need to understand math because we use it in the real world.
- I thought I could, but I cannot think of any.
- This is probably because those types of math questions are what I am accustomed to writing and what I most commonly see.

About 44 % of participants answered that they could write a mathematics story problem that is not connected with the real world and provided examples. The majority of examples suggested make-believe contexts containing words like "Martians", "flubbers", "aliens", and “unicorns”. Other examples included situations that put mathematics concepts into words, but cannot accurately represent reality due to their unrealistic context or incomprehensible situations for young students. Some examples are as follows:

- Janna made 800 pies and cut each pie into 100 equal pieces. She and her best friend each ate 500 pieces of pie. How much pie does she have left over? [unrealistic context]
- A farmer’s wife can carry two pails, each holding 4 gallons, from the creek to the barn. It takes 10 min with empty pails to cover the distance. It takes 20 min with both pails full. How long will it take to fill the thirty-gallon horse trough at the barn? [old life style today’s students are not familiar with]

Also, some participants provided mathematics questions in narrative forms, demonstrating the view that as long as the question is presented in a narrative format, rather than a symbolic-only form, it is a story problem. The following are two examples that participants claimed as mathematics story problems that are not connected to real-life:

- I am an even number. I am between the numbers 13 and 20. I can also be divided by 3. I cannot be divided by 5. What am I?
- I have three equal sides and three equal angles. What shape am I?

Discussion and implications for teacher education

A series of tasks in this study uncovered the prospective teachers’ collective perceptions of quality story problems for real-life connections. This section revisits the findings from this study and suggests remaining questions developed around several issues that would initiate further discussions and implications for teacher education programs.

Positive beliefs with insufficient specifics

The characteristics participants associated with quality real-life-connected story problems, as shown in the aspects they considered in collecting, posing, and evaluating story problems, demonstrated predominantly positive beliefs about the purposes and effective uses of real-life connections. About 40 % of responses collected stated that contexts relatable to students’ lives would be more meaningful and enhance their interest, motivation, and engagement. Also, even though not directly geared toward “real-life connectedness”, it is notable that more than 40 % of responses addressed the general characteristics of quality mathematics problems as the features of real-life-connected story problems. This implied that participants considered real-life-connected story problems one of the inevitable formats of mathematics problems. The predominant responses in the post-survey, stating that it is nearly impossible to create story problems without using real-life contexts, might share the same viewpoint. Based upon the aspects participants considered in collecting, posing, and evaluating story problems, as well as subsequent comments, there appeared to be a strong belief about the use of real-life-connected story problems in mathematics education among these prospective teachers. However, the considered aspects showed very few specifics about the participants’ understanding of what it takes for teachers and students to incorporate real-life connections into their teaching and learning processes. For example, it was not clear what was meant by the contexts being *relatable* to students or what is the ideal form of *hands-on activities* that promotes the real-life connection. Ten participants stated that hands-on activity is a critical aspect to consider in the design of a real-life-connected problem context. When examining their posed problems, it was not evident that the context demonstrated any hands-on applications as a necessary element in the problem-solving process. Several examples used store contexts and considered that acting out as a customer or a cashier handling charges, taxes, coupons, and making change was an example of hands-on activities. Other examples used measurement contexts. An example is as follows: “7/8 cups of cereal fills 1 ½ clear glasses. What fraction of the original cup fills 1 clear glass? Show your written work and draw an illustration that represents the problem and your answer.” This participant claimed that this story problem contained the nature of hands-on activities because students could fill up cups with cereal. As participants stated, their posed problems could be acted out or incorporate some activities; however, it is questionable how these actions help students discover or understand the mathematical concepts or processes in the contexts. Based on this part of the findings, it is doubtful whether these participants internalized the meaning of real-life connections at the personal level or perceived the idea of real-life connection as a factual, top-down, imposed recommendation teachers ought to follow. It is possible that participants emphasized the use of relatable contexts to students or hands-on activities simply because they were drawn from phrases they continuously heard in the teacher education program. In other words, it could be nothing more than a memorized or ritualized knowledge from various teacher education courses. Given this situation, one immediate challenge for mathematics teacher educators is how to unpack the widespread recommendations regarding the use of real-life-connected contexts for teachers or prospective teachers and how to help them critically evaluate and internalize these recommendations.

Reality: how real is real?

While participants’ criteria showed only a glimpse of the participants’ stance on real-life connections, the actual story problems created by participants and their evaluations on selected problems provided more specifics about their perspectives on real-life connections. The majority of participants believed contexts relatable to the student’s life would be an effective real-life connection. It appears that an agreement exists about the effectiveness of “reality” in the context, trusting the contexts would provide a richer condition for students to become more deeply engaged in the learning process.

Whereas participants shared the strong beliefs of the importance of reality in story problems, participants’ story problems and their post-evaluation of others’ problems revealed a vast discrepancy on how reality is defined and accepted by these prospective teachers. For example, slightly more than half of the participants (56 %) strictly defined the reality of the context as existing “here and now,” excluding any imaginary or non-current time contexts. In contrast, slightly less than half of the participants (44 %) accepted imaginary or non-current contexts as possible real-life connections. These results can be related to what Dutch educators are concerned about the misinterpretation of the term “realistic” in Realistic Mathematics Education (van den Heuvel-Panhuizen and Wijers 2005). The Dutch reform of mathematics education was called “realistic” not just because of its connection with the real world, but was related to the emphasis that Realistic Mathematics Education offers the students problem situations they can imagine. They also explain that “the context can be one from the real world, but this is not always necessary” and that “the fantasy world of fairy tales and even the formal world of mathematics can provide suitable contexts for a problem as long as they are real in the student’s mind” (van den Heuvel-Panhuizen and Wijers 2005, p. 288).

It was also noted that participants’ judgment on the reality of contexts widely differed, especially when they evaluated others’ story problems. As an example of an extreme case, some responses indicated that any mathematics questions in narrative form were real-life-connected questions (e.g., Example #2 in the questionnaire). The more evident difference in participants' judgments of real-life connections was regarding what information can be assumed versus what information should be explicitly provided. In the evaluation of Example #1, which was one of the highly rated items, many participants *assumed* that details such as possible traffic situations to get to the designated place or the warm-up time before the game could be ignored in terms of mathematical problem solving. Others believed that these minor details should be considered in the problem-solving process, since the real-life situations were much more complex than the given story problem stated. However, the problems containing very detailed information as an attempt to make the context more real were perceived as a negative aspect to the context (e.g., Example #5). While participants appeared to agree that the reality in the story problem would provide much richer contexts for students than context-free questions, it was found that varied conceptions of reality existed among participants.

It should be admitted that the pros and cons of the level of *realities* utilized in mathematics story problems exist in the current research literature. Within, they have numerous appeals to make mathematics questions close to reality. Also, a few research studies, as summarized in the literature review section, have reported students' and teachers' failure of considering reality in solving story problems. This indicates the importance of elaborating reality in the problem context. It is also noted that a detailed description or consideration of reality does not always guarantee the effective development of mathematical knowledge. For example, Inoue's (2008) study of undergraduate students revealed that incorporating familiar content in story problems was found to have only a limited impact; rather, fewer constraints could function to help students personally associate problem solving with their everyday experiences.

The findings from this study suggested that the participants' awareness about the importance of real-life connection in mathematics education was apparent, at least at its manifested level; however, it is not clear how the participants thought the incorporation of reality would contribute to the development of mathematical knowledge. Questions still remain for teacher educators to further investigate: How would the elaborated reality contribute to the understanding or applying of mathematics concepts? How much is *real enough* for the development of mathematical knowledge? What real-life-connected information is critical in terms of mathematics concepts beyond a superficial portrayal of the real world? What would be the desirable balance between mathematics and reality as story problems served the interplay between them?

Utilitarian view

It is noted that the majority of story problems created (about 98 %) focused on computational skills and that time and money were the most frequently used contexts (about 50 %). This implies that the majority of participants perceived that real-life connection has a value because of its usefulness. The same ideas were reflected in their evaluation on selected story problems. This is reminiscent of the concept of "shopkeeper math." The idea is that as long as kids can add, subtract, multiply, and divide and have enough skills to work in a store, then that is all the mathematics skills they will need. Participants' utilitarian view, considering knowledge as something that can be immediately and directly applied as worthwhile, implies how these prospective teachers perceived the nature and value of school mathematics. The participants' utilitarian view was also evident in their perceived purpose of real-life connections. The majority of participants described the real-life connections as useful in applying mathematics concepts in daily life. Only a few participants perceived the importance of the real-life connection as a context to support learning mathematics concepts. It is not the focus of this section to devalue the place of the typical traditional story problems in mathematics education or to criticize the usefulness of mathematics in our daily lives. It has to be admitted that there must be important features and functions of typical traditional story problems that contribute to mathematical understanding or to the application of daily life. The participants' perspectives were extremely unbalanced when considering the role of story problems as the interplay between mathematics and reality. This pervasive view is an issue to further discuss in contrast with what Carraher and Schliemann (2002) state, "Not all knowledge, perhaps not the most important knowledge, is immediately or directly useful." This issue is ultimately related to teachers' beliefs of the nature of school mathematics beyond the case of story problems. Teacher educators need to seek ways to provide prospective teachers with opportunities to reflect upon this issue.

Noted gaps: plausible reasons

The story problems participants posed do not reflect their perceived beliefs on real-life connections. Most of the story problems were typical "standard problems" which can be modeled or solved by a straightforward application of one or more arithmetic operations with the given numbers. This contrasted with their overly positive beliefs on the effectiveness of incorporating real-life connections. This finding implies that *what they think* and *what they do* are not necessarily identical, indicating there is a gap between the new vision of current mathematics education and the way prospective teachers learned through their past education. This possibility seems plausible; moreover, it further suggests that prospective teachers are aware of the importance of utilizing real-life connections in their teacher education programs at the general level, yet they are not fully exposed to the teachers' thinking process for the implementation of real-life contexts in mathematics education. As the most fundamental implication, there is a need for clarification of how the idea of real-life connection is presented and referred to in a mathematics teacher education program. This leads to the need for providing prospective teachers with explicit opportunities to examine the justifications behind their potential teaching strategies. Teacher educators might design a task to help shed light on what prospective teachers mean by *what they think*. It was noticeable that participants' justifications of the sample story problems were more elaborate and diverse than their initial criteria of quality story problems for real-life connections. This suggests to teacher educators that providing multiple prompts to facilitate reflection would be a feasible first step to narrow the gap between *what they think* and *what they do*.

Limitations of the study

The scope of this study was the participants' perceptions of real-life connections in the case of story problems. It was a deliberate choice to encourage prospective teachers to initiate their thought process using this familiar format. Asking participants to work on one format of real-life connections (i.e., story problems) can be a limitation of this study. Different results might have occurred if other formats for real-life connections were open to the participants. Also, this study focused on participants' perceptions based on their self-reported written data. It was not the intention of this study to make a prediction about what kind of interactions participants will have with young students in their future classroom settings. The results of this study are limited to offering an overall portrayal of a group of prospective teachers' *current* thoughts on real-life connections.

Concluding remarks

As Chapman (2006b) proposed, learning opportunities for prospective teachers should include not only how to solve problems, but also how to analyze, represent, and compare story problems. This study strived to provide such an opportunity by investigating prospective teachers' thoughts on real-life-connected story problems, not in their isolated problem-solving ability, but in their comprehensive ability to select, pose, and evaluate story problems. It is believed that the findings from this study provide some insights into mathematics teacher educators so that they can employ suitable approaches.

This study reveals that there are many assumptions made among prospective teachers about real-life connections and that there is much more to learn from these prospective teachers. This study sought to provide prospective teachers with an opportunity to reflect upon their current beliefs and conceptions. It is necessary to provide prospective teachers with the opportunity to reflect upon their beliefs about the role of real-life connections in the classroom, as this study attempted to show. As Ball (1991) suggested, this kind of experience will be important because teachers' conceptions form boundaries around the explanations they offer students and this type of knowledge is often not explicitly recognized. It is hoped that the knowledge generated by this study will bring up further discussion about prospective teachers' beliefs and perceptions and to provide more contextual factors to be considered in mathematics teacher education.

Undoubtedly, more work is needed to gain further insight into prospective teachers' present perceptions of real-life connections. First, a future study would focus on in-depth tracking of the individual prospective teachers' transformation process, focusing on how their perceptions will change in the long term and how their beliefs will eventually be embodied in their actual instructional practice. Second, considering the fact that the findings from the current study are based on the general mathematics methods course with no explicit teaching about real-life connections, a future study would develop a strong course on the strengths and limitations of using real-life contexts and then investigate the prospective teachers' take-up of the ideas in the course. This would provide more contextualized factors to be considered for mathematics teacher educators. It is hoped that the findings of the current study provide teacher educators with some practical implications for designing their courses, while guiding prospective teachers.

Appendix: Post-questionnaire

Real-life-connected math stories evaluation

<Part I > Please evaluate the following math stories. For each math story,

(1) Please indicate the quality of real-life connection on a scale of 1–5, with 5 representing the highest quality.
(2) Explain the strengths of the math story in terms of the real-life connection.
(3) Explain the shortcomings of the math story in terms of the real-life connection.

<Sample story problems used for evaluation>

Example 1. Grade: 2

You are invited to a birthday party at Classic Bowling lanes. The party begins at 12 pm [noon] and ends at 2 pm. But you have a soccer game that starts at 2 pm. The bowling alley is a half hour away from your soccer field. What time will you need to leave the party to make it to your soccer game on time?

Example 2. Grade: 3

I have four equal sides with four equal angles, what shape am I?

Example 3. Grade: 3

Each lunch table in our cafeteria holds a maximum of 22 students. If there are 102 students eating at lunch today, how many lunch tables will we need?

Example 4. Grade: 3

John and his Mom and Dad went to the apple orchard. Each member of the family has a basket, that's 3 baskets to fill with apples. The family each put 6 delicious looking apples in their baskets. They had 3 baskets with 6 apples in each, how many apples did the family have all together?

Example 5. Grade: 3

Tom and Tim were having some friends over to watch a movie. They wanted to order pizza for everyone but they weren't sure how much to get. Jet's Pizza was offering specials on Supremes, cheese and pepperonis, and Hawaiians. Small pizzas have 5 pieces, mediums have 7 pieces, and larges have 10 pieces. So, Tom and Tim asked their friends which kind and how many pieces of pizza they would like. Max and Sam each wanted 2 slices of Supreme and 3 slices of Hawaiian. Sally wanted 3 slices of cheese and pepperoni. Greg wanted 2 slices of cheese and pepperoni and 1 slice of Hawaiian. Wally ordered 2 slices of Hawaiian, 1 slice of cheese and pepperoni, and 1 slice of Supreme. Finally, Tom and Tim decided what they would eat. Tom and Tim each wanted 4 slices of Hawaiian, but Tom also wanted 1 slice of cheese and pepperoni. But, just as Tom went to call Jet's, Sally decided to change her order. She now wanted to change one of her slices of cheese and pepperoni to a slice of Supreme. Which kinds and sizes of pizzas should Tom and Tim order so that everyone will get what they ordered?

Example 6. Grade: 4

Use the clues to find the numbers

1,000 s	**100 s**	**10 s**	**1 s**

1. Write 5 in the tens place.
2. Find ½ of 24. Subtract 4. Write the result in the hundreds place.
3. Add 7 to the digit in the tens place. Divide by 2. Write the result in the thousands place.
4. In the ones place, write an even number greater than 2 that has not been used yet.

Example 7. Grade: 3
Mr. and Mrs. Smith have five sons, each born 2 years apart. From the data below, figure out the birth order of the sons and their ages.
Edward is older than Michael and Ian.
Michael is 4 years older than Larry.
Yves was born when Edward was eight.
Ian is now 6 years old.

Example 8. Grade: 4
"All 20 of my students have been working very hard all week during math. I think they deserve a break for a little snack. I'm going to bake cookies for them tonight." Said Mrs. Lynn to her husband, Mr. Lynn.
"That's a good idea. If you make the cookies smaller than normal, each student would be able to get more cookies!" said Mr. Lynn.
"I think that is a great idea, I know my students will love that too." Said Mrs. Lynn.
"Wow, it sure smells good in here tonight." Said Mr. Lynn.
"That's what 80 little cookies smell like. Yummy isn't it?!" asked Mrs. Lynn.
How many little cookies does each student receive from Mrs. Lynn?

Example 9. Grades: 5
Your parents are planning on taking you and your siblings on a family trip to see your grandparents who live in Tampa, Florida. Dad wants to know how many times he will have to stop for gas if he travels at 60 miles per hour and his car gets 30 miles to one gallon of gas. The gas tank holds 20 gallons of gas and you are going to be driving 1,800 miles.

Example 10. Grade:8
You have a collection of sports cards with exactly four types of cards (soccer, baseball, basketball, and Nascar). The soccer and basketball cards make up 60 % of the collection, and the basketball and baseball make up 20 % of the collection. If the 18 baseball cards in the collection represent 5 % of the total number of cards, how many of the cards are Nascar?

<Part II>

1. Do you think real-life-connected math stories are more appropriate for specific concepts (e.g., time, money)? If so, why?
2. Can you create a math story that is not connected with a real-life context? If so, please provide an example.

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