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A subtraction game to scaffold primary students' word problem solving skills

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Abstract

Solving arithmetic word problems has been a challenge for primary students due to difficulties in understanding the problem structure and relating the quantities in the problem to each other. This paper reports on an action research study to enhance students' subtraction word problem-solving skills. The authors observed that their students had difficulties in representing the situations in word problems and solving the problems correctly. They designed, implemented, and analyzed an intervention to scaffold their students' subtraction word problem-solving skills. As part of the intervention, a digital subtraction game was developed and used with second and third-grade students. The game involves three different representations: a discrete visual model, a bar model, and a number sentence. The students played the game and solved additional problems to strengthen their skills for representing and solving subtraction word problems. Twenty-four 2nd grade students in China and two 3rd grade students in Turkey participated in the study. Data sources included a pre-test, a post-test, student worksheets, and teachers' filed notes. Data analysis showed an increase in students' subtraction word problem-solving performance. They also effectively used a variety of representations to represent problem situations. The design and implementation processes of the intervention are discussed in the paper. We share suggestions for future implementation.

Keywords: Game-Based Learning, Problem-Solving, Subtraction Word Problems, Technology-Enhanced Instruction

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Teaching how to solve arithmetic word problems has long been an interest of mathematics educators due to the challenges that students face when working with word problems (Carey, 1991; Carpenter et al., 1988; Fuchs et al., 2021; Kaur, 2019). The main difficulties that students experience when solving word problems involve comprehending the problem structure and relating different quantities mentioned in the problem situation to each other (Cummins, 1991; Daroczy et al., 2015; Mason, 2018; Van de Walle et al., 2019). Polya (1945) took the lead to propose a systematic approach to teach problem-solving to students by introducing a four-step model: understanding the problem, devising a plan, carrying out the plan, and looking back. This model can be used to solve arithmetic word problems as well. Since Polya's problem-solving model, different strategies have been proposed in the related literature to help primary students excel in solving arithmetic word problems such as the concrete-pictorial-abstract model (Ang, 2008; Kaur, 2019), schema-based instruction (Powell, 2011; Willis & Fuson, 1988), or the Davydov curriculum (Schmittau & Morris, 2004). As solving arithmetic word problems continues to be a challenge for primary students (Capone et al., 2021; Kenedi et al., 2019), developing and investigating new approaches for improving students' word problem-solving skills is a valuable endeavor for the community of mathematics teachers, learners, and researchers. This study aims to contribute to mathematics education and the related literature by sharing the design and implementation processes of a subtraction game used to scaffold second-grade students' word problem-solving skills.

The idea of designing a game to teach subtraction word problems was initiated from the authors' experiences with young learners. At the time of this study, the first author was conducting research with primary school students in Turkey and the second author was a second-grade room teacher in China. Both authors noticed their students' difficulties with solving word problems. For example, most of the students (84%) in a second-grade classroom in Turkey selected choice A to answer the question given in Figure 1. Most explained their reasoning based on the operation needed to find the unknown number such as "because I will subtract 32 from 46 to find the answer." In solving word problems, number sentences are mainly used for two purposes: a) to represent the action in the problem, and b) to solve the problem (Carey, 1991; De Corte & Verschaffel, 1985; Gooding, 2009). Students who can represent the action in a problem tend to solve it correctly (Carpenter & Moser, 1982; Carpenter et al., 1988). The action of the problem in Figure 1 can be represented by 46 –? = 32. On the other hand, the number sentence 46 – 32 =? can be used to solve the problem. It is important for students to represent the problem situation and then translate one number sentence into an equivalent form. Our students seemed to struggle with representing the action in the problem. We also knew that some students were struggling with solving subtraction word problems with an unknown change and unknown start. Therefore, we decided to develop a series of lessons as an intervention to help these and other second graders to enhance their subtraction word problem-solving skills.

Tim had 46 toy cars. He gave some toy cars to Alice. Now Tim has 32 toy cars. How many toy cars did Tim give to Alice?

Which of the following number sentences best represents the situation given in the problem above?

A) $46 - 32 = \square$

B) $\square - 46 = 32$

C) $46 - \square = 32$

Explain your choice:

Figure 1. Representing Subtraction Word Problems

METHODS

We decided to conduct a collaborative action research study as we both observed similar difficulties in our students. Action research is a methodology often used by practitioner-researchers to generate knowledge from analyzing their own practice and then use this new knowledge to improve their practice (McNiff & Whitehead, 2010; Somekh & Zeichner, 2009; Vaughn et al., 2014). We followed the phases suggested by McNiff and Whitehead (2010) to conduct our collaborative action research: *getting started, planning, and designing the project, doing the project, evaluating*, and *disseminating*. The *getting started* phase includes identifying a problem area, discussing it with colleagues, and reading the related literature on the problem area. As explained above, we identified "teaching how to solve subtraction word problems" as an area to investigate in our practice. *Planning and designing the project* involves designing an intervention to enhance the problem area identified in phase 1 and formulating a research question. After reviewing and reading the related literature on children's thinking on arithmetic word problems (e.g., Carpenter et al., 1988; Van de Walle et al., 2019) and their developmental levels (e.g., Fisher, 2014; Parks, 2015; Wood, 1998), we decided to design a digital subtraction game as part of our intervention and named it Subtraction with Gleeb. The design process of the game and the intervention will be described in detail in the Designing the Intervention section. We formulated the research question as follows:

How does the Subtraction with Gleeb game help primary school students solve subtraction word problems?

The *doing the project* phase is about monitoring the implementation of the designed intervention and collecting relevant data. As the second author had daily access to a second-grade classroom, he used the intervention with his students. There were 24 second-grade students in his class. Data sources of the current study involved a pre and post-test, students' worksheets from the intervention, and the teacher's field notes. The first author used the game with two 3rd grade students, Ali and Rana, at the beginning of their third grade and audio recorded the gameplay during levels 3, 4, and 5. According to their class teachers, Rana and Ali were average-performing students in mathematics. Although the study is mainly based on the whole class implementation, the field notes and audio recordings from the small group implementation have also been used as supporting evidence. All names used are pseudonyms.

The *evaluating* phase involves data analysis, assessing the effectiveness of the intervention, articulating the significance of the intervention, and reflecting on the personal learning. This phase will be shared in the Using the Game with Students and Discussion sections. Finally, the *disseminating* phase includes sharing the results of the intervention and personal learning with the larger education community through presenting or writing a paper.

Designing the Intervention

Our collaboration focused on enhancing students' conceptual understanding and procedural fluency (Kilpatrick et al., 2001) in solving subtraction word problems. Taking into consideration that young learners are fascinated by playing games, we decided to design our intervention by drawing upon the game-based learning approach. Games have the potential to create an interactive learning environment that engages and motivates students (Olson, 2007). A good mathematical game should provide opportunities for students to explore mathematical concepts and engage in rich discussions. We started the game design process by first considering which representations to include in the game. The representations used in learning tasks afford particular forms of actions to students and thus significantly affect their meaning-making processes. In this action research, we decided to engage students in working with three types of representations: a discrete visual model, bar model, and number sentence (Figure 2). The representations were purposefully selected to help students transition from concrete to more abstract thinking (Ang, 2008; Kaur, 2019). We designed a discrete visual model (game board) that allows students to represent the problem situation. Then, as a more abstract representation, students used bar models. Models help students move from situational level to referential level as they are required to represent the model of the problem context (Murdiyani et al., 2013). Constructing a bar model enables students to relate the quantities involved in a problem (Ng & Lee, 2005; Osman et al., 2018) and is based on schema-based instruction (Powell, 2011; Willis & Fuson, 1988). Finally, the students represented the problem situation with a number sentence. Working with number sentences in word problems helps students develop meaning for mathematical symbols (Carey, 1991).

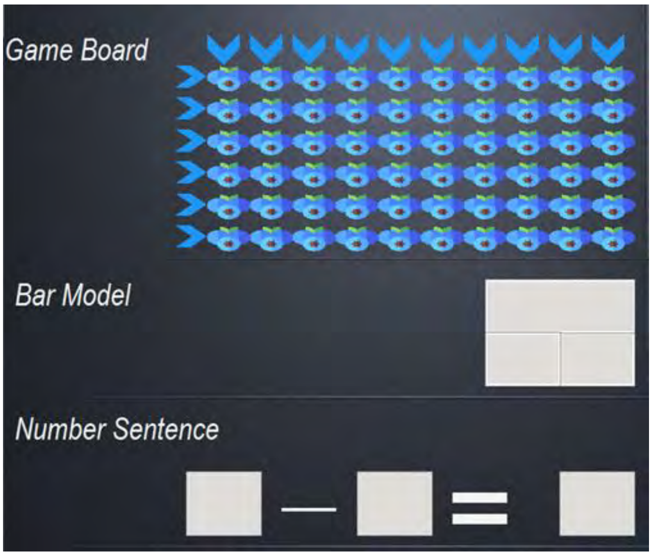
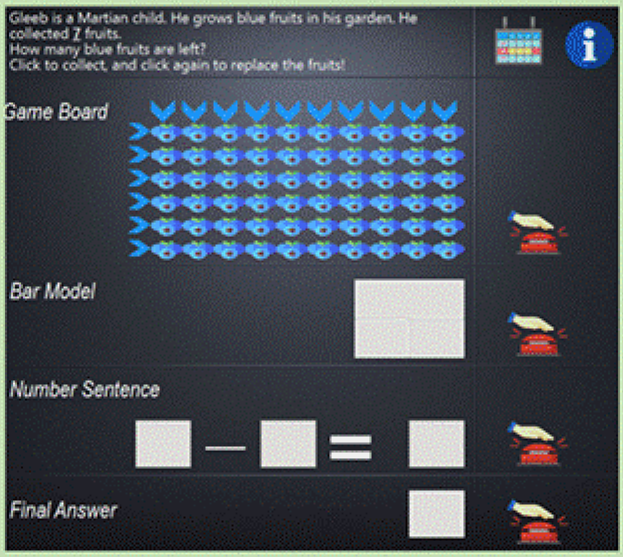


Figure 2. The representations used in the game

We should note that initially, we searched for an existing game that involves all the representations that we decided to use in the intervention lessons. Since we could not find such a game, we designed a game for the second graders to achieve the following learning objectives: a) Represent the action in a subtraction word problem using different representations including a visual model, bar model, and number sentence. b) Make connections between different representations. c) Perform the subtraction or addition operations to solve the given problems using standard algorithms and/or mental strategies. The game was first constructed using a spreadsheet program, later it was developed into a more functional and entertaining game by a programmer. Figure 3 presents the details of the game. The final version of the game can be downloaded at https://sourceforge.net/projects/subtraction-game/. On this website, the game will be downloaded as a rar file (please choose Released /subtraction-with-gleeb.rar). Once the file is extracted, the file name with exe extension (subtraction-with-gleeb.exe) should be run to play the game.

Subtraction with Gleeb



- The game has 5 levels. The students are required to play each level 6 times. The reward at each level is a hidden picture. Each level has a different picture reward (e.g., cute animals). The pictures are hidden behind 6 blocks; after each round is played, one block is removed.
- Students earn scores as they move from one round to another. At the beginning of each round, the game asks students a subtraction problem. The students need to represent the problem situation using three representations: game board, bar model, and number sentence. Finally, they need to enter the answer. For each step, they earn 1 point if they are correct on the first try. So, in each round, a student can score 4 points maximum, totaling 24 points for each level.
- Level 1 and Level 2 ask subtraction questions with an unknown result. The change is randomly selected between 1 and 15 for Level 1 and between 20 and 40 for Level 2. The start is 60 in all questions.
- Level 3 and Level 4 ask subtraction questions with an unknown change. The result is randomly selected between 45 and 60 for Level 3 and between 20 and 45 for Level 4. The start is 60 in all questions.
- Level 5 asks subtraction questions with an unknown start. Both the change and the result are randomly selected between 20 and 30.
- All the questions were created using the same scenario. To make the context interesting and fun, a scenario involving a Martian child (Gleeb) was used.

Figure 3. Details of the Subtraction Game

Subtraction with Gleeb game was a key aspect of our intervention. However, we needed to design a comprehensive instructional plan that focused on the game. We utilized the digital game-based pedagogies framework proposed by Hébert and Jenson (2019) to design and deliver our intervention as follows:

1. *Teacher knowledge of and engagement with the game during gameplay:* During the game-design

process, we played the game multiple times with elementary school teachers and revised aspects of the game to reach the learning objectives outlined above. As the authors developed the game collaboratively, they were both highly knowledgeable about how to play the game.

2. *Focused and purposeful gameplay:* During the gameplay, the teacher-directed students' attention to important mathematical ideas such as how different representations are related to each other or how to use mental strategies (e.g., using multiples of 10 as a bridge) to perform the operations.
3. *Collaborative gameplay:* Levels 3, 4, and 5 of the game were played in pairs to promote collaborative learning. Students who used more concrete strategies were partnered with students who used more abstract strategies but not with advanced abstract thinkers as they may be out of each other's zone of development (Olson, 2007).
4. *Meaningful learning activities:* The levels of the game were played on different days. This allowed the teacher to use additional problem-solving tasks that complement the gameplay. The students solved different contextual problems to deepen their knowledge of the new representations that they learned.
5. *Cohesive curricular design- Structured lessons:* The lessons were planned in detail as part of a review of the subtraction topic. The game was not played as a separate activity. The students worked on different subtraction and addition tasks during the whole week. The final lesson asked students to create their own subtraction word problems. Then, they switched them with a partner and solved each other's problems.
6. *Appropriate lesson pacing and clear expectations:* The teacher structured the lessons so that multiple tasks (e.g., gameplay, problem-solving) were completed in each lesson. The students were given concrete time frames to complete the tasks.
7. *Technological platforms not a point of focus:* The teacher frequently directed students' attention to mathematical concepts involved in the game by asking open-ended questions such as "Aysha counted the fruits by 10s, how can we count them differently?" These questions helped students to share different problem-solving strategies with each other.
8. *Game positioned as a text to be read:* Connections were made between the game and other learning materials. For example, the students were asked to utilize the models used in the game during their regular problem-solving sessions through worksheets.
9. *Connections to prior learning and to the world beyond the game environment:* During the game, the teacher encouraged students to use mental strategies that they learned before such as counting by 10s or using multiples of 10 as a bridge for adding or subtracting numbers. For the activities out of the game context, the students were reminded of the strategies and representations used in the game.

RESULTS AND DISCUSSION

Using the Game with Students

In order to gauge the students' current knowledge and problem-solving skills, a pre-test was completed by the second-grade students in the second author's class. Figure 4 shows the questions included in the pre and post-test. An analysis of the students' responses revealed that in the pre-test, the students were able to answer 68% of the questions correctly. The average score of the class (n=24) was 2.04 out of 3 points. During the pre-test, almost half of the students (46%) did not use representations to solve the problems. Of the ones that did, they were limited to a number sentence representation such as 98 – 63

= 35 for problem 3.

Pre-Test/Post-Test

1) Alice had 84 toys. Then she gave 26 toys to Cindy. How many toys does Alice have?

2) Jon had some toys. Then he gave 15 toys to Robert. Now Jon has 73 toys. How many toys did Jon have to start with?

3) Patrick had 98 toys. Then he gave some toys to Bill. Now Patrick has 63 toys. How many toys did Patrick give to Bill?

Figure 4. Pre-test/post-test questions

Different Approaches to Implementation

There are different ways that Subtraction with Gleeb game can be implemented. In this circumstance, it was delivered in the following way due to the teacher only having one computer in the classroom. The teacher ran through each level of the game on his computer and smartboard, and the whole class did written work on paper using the printouts of the representations included in the game. Students were motivated through the revealing of the hidden picture and the reward system the game has embedded (gaining 1 point for each correct representation and for giving the correct answer). To increase the student-led nature of the game, the teacher had a student take over leading the game on the computer after level 2.

If the teacher had access to a computer lab or a class with many computers, two students could play against two other students, moving through the levels and gaining scores at each stage. Students could be grouped differently should the class size and/or access to computers be limiting. In the implementation led by the first author, two students played the game using one computer. They decided how to respond to each question collaboratively and took turns to press the buttons of the game.

Introducing the Game

The game was introduced to the students using the context of a Martian child, Gleeb. He grows fruits in his garden and needs help in figuring out the number of fruits as he collects them. The teacher led the introduction in a step-by-step manner. The game board and how to collect and replace fruits by clicking on the game board were introduced. The students were told that if they engaged with the game, they would earn rewards, and more importantly, they would enhance their word problem-solving skills. In line with Hébert and Jenson (2019), clear expectations were conveyed to the class, letting them know how many levels there would be and the nature of each level. The technological platform was not drawn to be the main point of focus, instead, the teacher drew the students' attention to the different problem-solving methods they could use.

Playing Levels 1 and 2

In the whole class implementation, the students played the first two levels providing their answers individually. The teacher led both levels. At levels 1 and 2, the problems are constructed so that the result is unknown (See Figure 5). First, the problem was read aloud. An example problem from level 1 is as follows: "Gleeb is a Martian child. He grows blue fruits in his garden. He collected 14 fruits. How many blue fruits are left?" The students are told that the game board represents Gleeb's garden. Lee asked, "How many fruits are there in the garden?" The teacher acknowledged that this was a great question and asked the class how they could count the fruits using mathematical thinking. Some started counting the fruits one by one, but they quickly noticed that the garden was organized into 6 rows and 10 columns. Taio counted by 10s and found that there were 60 fruits in the garden. The teacher asked if there was another easy way of counting the fruits. Peng counted by 6s and reached 60 as well.

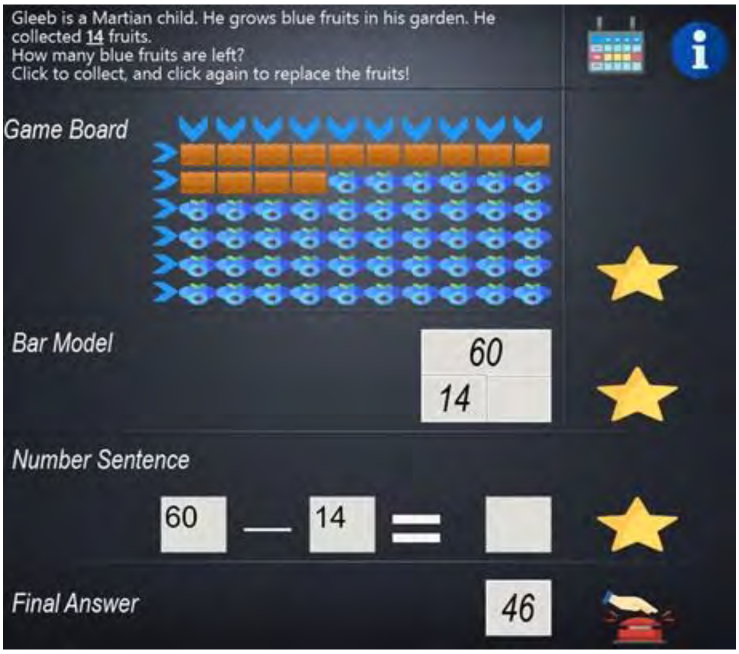


Figure 5. An example problem at level 1

Next, the problem was represented using three models: game board, bar model, and number sentence. Initially, the students were eager to find the answer, but the teacher explained that one goal of the game is to learn how to show a problem situation using different models and this is an important skill of good problem solvers. The representations of the example problem are given in Figure 5. The students represented the problem situation using their printouts. Then, they used different strategies to calculate the answer. Some used the standard algorithm to subtract 14 from 60, some used mental strategies (e.g., 60-10= 50, 50-4=46) and some counted the left fruits on the game board. All these different strategies were shared in class to promote peer learning. They were asked how to check the correctness of their answer before clicking the check button. Nkechi said, "Blue fruits plus the brown boxes should be 60." The class used this strategy and made sure that the answer was correct.

In the small group implementation, the students quickly discovered that they do not need to color the game board one by one. Instead, they used the arrows to color a whole row or column. This feature of the game promoted different ways of coloring the number of collected fruits (change). For example, to color 18, Ali colored two whole rows (20) and then clicked on 2 fruits again to make the colored section 18. When the teacher asked if they could color 18 in a different way, Rana used the arrows for the columns and colored 3 of them (3x6). They counted by 6 and made sure that 18 fruits are collected (turned into brown color).

Playing Levels 3 and 4

The students played these two levels collaboratively in pairs. In order to enhance peer learning and peer support, as mentioned previously, students with more concrete representation methods were paired with students who have more abstract methods (Olson, 2007). This was selected by looking at their ability to represent their problem-solving methods during levels 1 and 2. Starting with level 3, one of the students was selected to lead the game on the teacher's computer. Students enjoyed this and many of them asked to be this student: "Teacher, can I do that on the next level?"

In these levels, the problems were constructed so that the change was unknown. The students in both implementations noticed that they needed to subtract the result from the start number to find the change. The game board and the bar model seemed to help students notice the part-whole relationship between the numbers. For the question given in Figure 6, Rana (small group implementation) colored the game board as shown in the figure, pointed to the left bottom corner of the bar model, and said, "We need to figure out this part." The conversation continued as follows:

Rana: 60 minus 34. 60 minus 30 is 30 and 30 minus 4 is 26.
Teacher: How can we check this answer?
Rana: I can count by 3.
Ali: Count by 9: 9, 18 and then add 8, 26.
Rana: Yes.
Ali: If you count by 3, there will be 2 extras.
Rana: 3 times 8 is 26.
Teacher: you mean 24?
Rana: yes, 24, and 2 more, 26.

The way that students colored the game board opened up opportunities for different calculation strategies as evidenced in the excerpt above. The brown section in Figure 6 was counted in three different ways: skip counting by 3s, counting by 9s, and counting by 8s. Discussing these different strategies is helpful for students to build robust number relationships.

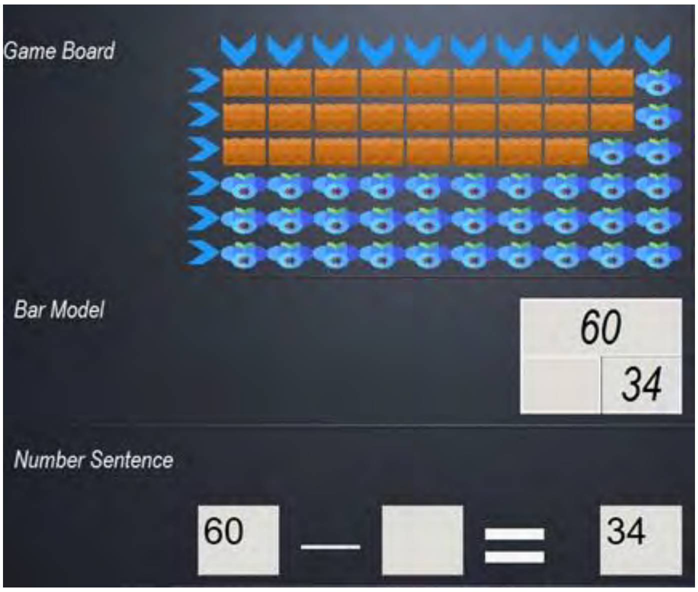


Figure 6. Example Representations at Level 4

By this time, the students got used to the game context and to using the different representations.

The teachers helped students make connections between different representations. For example, in the whole class implementation, the teacher asked the students if they noticed a relationship between the bottom parts of the bar model and the top part. Yang shouted excitedly "Oh, I see, when we add those two numbers, we get 60." The teacher connected this comment to the problem context by saying "Great observation, if we add the number of collected fruits and the number of remaining fruits in the garden, we should get the initial number of fruits, which is 60."

One limitation of the game is that in levels 1-4, the initial amount is always 60. To overcome this limitation and to help students transfer their knowledge to other contexts, the students solved extra problems given in different contexts that use a variety of numbers.

Playing Level 5

For level 5, the students solved subtraction problems with unknown starts. Both the change and the result are randomly selected between 20 and 30. The students needed to figure out how many blue fruits there were at the beginning (Figure 7). They worked in pairs to produce representations of this through coloring the game board, creating a bar representation, and writing a number sentence. They needed to present an answer too. At the beginning of this level, the teacher emphasized that the white parts are not part of the garden, and the number of fruits does not have to be 60 anymore.

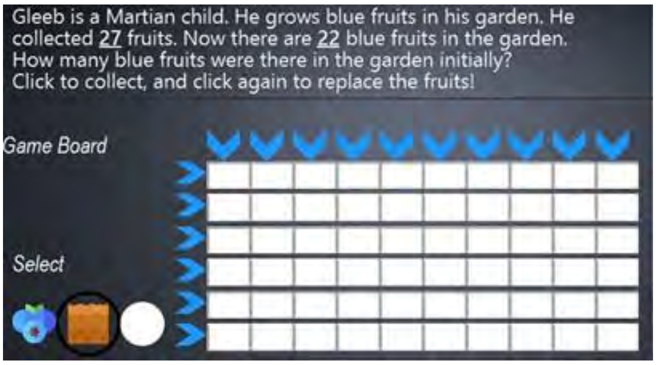


Figure 7. A Sample Problem at Level 5

The students stated a number of things during this lesson, these statements indicate collaboration and problem-solving competencies. Students enjoyed the collaborative nature of this level. It is important to note that this kind of collaborative problem solving was not common in the class prior to this intervention. Some amount of this manifested in level 3 and level 4, but during level 5, it was rife. Regarding collaboration, the students got used to sharing work with their partners. For example, Rio said, "I can do this part and you can do this part." This demonstrates the splitting up of workload as opposed to students simply allowing one member of the pair to do all the work.

Different from the other levels, this level had varying start numbers. Students discussed this difference as they worked on the problems. For example, Chun questioned why the top number on the bar model was not 60. Hui, her partner, explained, "It's not 60 on top because the white squares didn't include in the game, so only plus the brown and blue." The students also corrected each other's calculation errors. For example, Hong calculated the answer as 49 for one of the problems. Lan disagreed: "It's not 49 on top because 25 plus 28 equals 53." This statement demonstrates a student correcting an error that his partner made. This gave Hong a chance to learn from Lan and provided them with a problem-solving rationale that was appropriate. To find the answer, some students added the number of collected fruits and the number of remaining fruits. Some other pairs subtracted the number of white squares from 60.

During the game, the teachers monitored the students' progress and sometimes posed questions to help them make their thinking processes explicit. These questions varied from asking for different subtraction or addition strategies to making connections between different representations such as "How do numbers in the bar model relate to the garden?" or within one representation "How do the numbers on the bar model relate to each other?" These questions scaffolded students' reasoning process about the different representations used in the game. At the end of the game, the small group had the following dialogue:

Teacher: Let's discuss how the numbers on the bar model relate to each other. What does each part represent?
Rana: Minuend, subtrahend, and difference.
Teacher: Okay, how do they relate to each other?
Rana: For example, 27 subtracted from this number [pointing to the top part of the bar model] is 22. And if we add the two numbers [pointing to the bottom parts], we get this number here [pointing to the top part].
Ali: Or if we subtract this number [subtrahend] from this number [minuend], we get this number [difference]. Or if we subtract this number [difference] from this number [minuend], we get this number [subtrahend]. It works both ways.

The students explained the relationship between the numbers on the bar model in different ways. Playing the game multiple times strengthened their understanding of using the bar model to solve subtraction problems. The students also related the numbers on the bar model to the gameboard using the game context upon the teacher's questions.

Post-Test

After playing all five levels of the game, the students took the post-test. They were able to answer 95% of the questions correctly (an increase of 27%, see Table 1).

Table 1. Pre-test and Post-test Results

	Pre-test	**Post-test**
Average score out of 3 points	2.04	2.84
Percentage of correct answers	68%	95%

They also used a variety of representations including number sentences and the bar model. An example of a typical student answer is given in Figure 8.

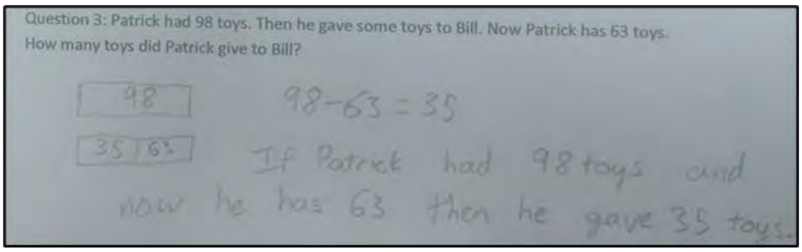


Figure 8. An Answer to the Post-test Question 3

In addition to the post-test, we asked the students the question in Figure 9 to assess whether they were able to correctly represent the action in the problem. 96% of the students answered the question correctly by selecting choice A and 88% provided a correct explanation. Both the post-test and the additional question results indicate that as the students improve their representation ability, they also improve their percentage of correct answers. This backs up Carpenter et al. (1988) and their point that correct representations tend to produce correct answers. It also indicates the game was successful at improving students' ability to represent and answer subtraction problems.

Richard had some marbles. Then he gave 23 marbles to Mary. Now Richard has 39 marbles. How many marbles did Richard have to start with?

Which of the following number sentences best represents the situation given in the problem above?

A) $\square - 23 = 39$

B) $39 - \square = 23$

C) $\square - 39 = 23$

Explain your choice:

Figure 9. A Question on Representing the Action in the Problem

CONCLUSION

In this article, we shared the design and implementation processes of a digital subtraction game that was used with second and third-grade students. The digital game-based pedagogies framework (Hébert & Jenson, 2019) guided the design and implementation processes. The students worked with three different representations (a discrete visual model, bar model, and number sentence). These were used consistently throughout the gameplay, and they solved additional problems complementing the game. The class observations and the pre- and post-assessments revealed that the students enhanced their representations skills related to solving subtraction word problems. Their performance on subtraction word problems also increased. Based on these results, we recommend that other teachers use the game with their students.

This game and the evidence provided support the assertion that through the development of game-based tools and technologies, which integrate the motivating aspects of games, students can learn the targeted concepts meaningfully (Tobias et al., 2014). One of the key issues that were considered during the creation and reflective development of this game is as follows: Often, games which are designed for learning are missing design processes that "ensure that learners will acquire the specific knowledge and skills the games are intended to impart." (Tobias et al., 2014, p. 485). This was combatted by ensuring the game was focused on the desired learning outcomes. For instance, all game points were gained through the use of multiple representations and the application of subtraction strategies. This is more than likely a substantive part of the reason why this game represented the major positives of game-based learning pointed out by a meta-analysis which said: "…using mathematical computer games for teaching influences formation of a positive attitude of pupils" and "…it is evident that using mathematical computer games for teaching contributes to more efficient and quicker realisation of educational goals at all levels of education" (Divjak & Tomić, 2011, pp. 27-28). This study has backed these two points up as far as it is evidenced from teacher reports of the students' engagement levels and the increased performance of students' ability to represent and solve the subtraction word problems correctly.

In regard to the solving of subtraction word problems using representations, the game allowed students a variety of methods. One that was planned, to some degree, but manifested very strongly due to the collaborative nature of the gameplay, was the verbal expression and solving of problems. This was a particularly positively welcomed outcome as it corresponds with Carpenter and Moser's (1982) indication that verbal problems give meaning to addition and subtraction. They go on to talk about how this may be a suitable option to consider when enhancing the teaching and learning of these key mathematical areas in schools. These findings considered, when creating game-based learning strategies relating to these areas in the future, this approach will be replicated in an attempt to take advantage of this key learning area.

Our students already worked with subtraction word problems earlier in the year. We used the current game for review and remedial purposes. Other teachers might use the game as their students' first attempt to solve subtraction word problems. In such circumstances, the levels of the game might be played on different days or weeks. Another adaption could be made regarding the problem structure. The game we used is an open-source game. Other developers might revise the game to include different types of problems (e.g., comparison) involving different numbers or operations depending on the needs of their learners.

Acknowledgments

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Declarations

Author Contribution	:	EE: Conceptualization, conducting the case study, writing. GMAM: Whole class implementation, writing.
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