

Full Length Research Paper

Analyzing students' views about mathematics teaching through stories and story generation process

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The purpose of this study is to investigate primary mathematics education students' views about mathematics teaching through stories and the story generation process. To this end, the study attempts to help primary mathematics education students to create stories for teaching middle school students mathematics and to gain experiences through the story generation process. Accordingly, the research question was formulated as follows: "What are the views of 3rd grade primary mathematics education students about mathematics teachings through stories and the story generation process? This study is of importance as it involves the evaluation of the use of stories in mathematics teaching. Additionally, within the scope of the study, mathematics education students made stories of mathematics subjects according to middle school students' level and produced an instructional material that can be used in mathematics classes. The study group consisted of 12 third-grade students studying primary mathematics education. The study used a case study research design which is an interactive qualitative research design. The data were analyzed through content analysis. The views were presented under a set of themes and categories. According to the views of the participating students, mathematics teaching through stories arises interest in topics and provides clarity, promotes love for mathematics and imagination, fosters the reinforcement and retention of mathematics topics, facilitates establishing connections with everyday life, fosters student engagement, can be used as a tool of role-playing and as a technological support, promotes students' mathematics achievement, facilitates understanding abstract and difficult mathematical concepts, and offers such benefits as imagination and retention. The participating students also stated that the story generation process helped them to gain empathy, creativity, and the skills of concretization and level-setting, to reflect on their own story generation processes, to use their imagination, to discuss stories, and to digitize stories and convert them into a book.

Key words: Mathematics teaching, mathematics teaching through stories, primary mathematics education, student views, story generation process, mathematical stories.

INTRODUCTION

More emphasis has recently been placed on students' willingness to learn rather than the structure of knowledge. Thus, students' willingness to learn should be taken into account while organizing learning

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environments. The easiest way to make students willing is to associate subjects with everyday life. The association of concepts with everyday life is not sufficiently addressed in schools. Thus, concepts are only learned by rote as no link is established (Demircioglu et al., 2006).

Mathematics is today a necessity and a high-priority requirement in every area, which requires high-level mathematics teaching practices to facilitate students' permanent and pragmatic learning. Additionally, there is a need for people who know and love mathematics in order to be advanced in mathematics. Negative beliefs about mathematics begin at an early age and grow exponentially. Thus, teachers have great duties (Coskun, 2013). There is a need for more contemporary teaching methods and techniques that enable students to reach only necessary information rather than excess and redundant information (Coskun, 2013). There is also a need for teaching materials that make learning meaningful, associate concepts with everyday life and make students willing to learn and responsible for their own learning (Demircioglu et al., 2006). One of the methods that can be used to this end is mathematics teaching through stories.

Storytelling is an activity based on the narration of truth or fiction as a speech or writing in prose or poetry to inform or entertain listeners and readers. Stories are used to provide an emotional meaning to our lives and to events that are considered quite ordinary. Stories allow people to understand and associate ordinary events with each other, helping to transform them into emotionally meaningful models (Shirley, 2005).

Stories can encourage students' and teachers' ideas and prevent misconceptions. They can also be a powerful way to reveal students' and teachers' mental models of the world, to help them share their understanding of a topic, and to ameliorate the rote-learning based education approach (Demircioglu et al., 2006).

Teachers often try to improve students' logical and analytical skills in the classroom setting. Stories facilitate developing the faculty of imagination as it is the most important strength of students (Balakrishnan, 2008). They also stimulate students' imagination and sense making (Demircioglu et al., 2006). Thus, teaching through stories is a very powerful tool that can provide students with rich, energetic, meaningful and lasting imaginations (Goral and Gnadinger, 2006). Listening to a story stimulates imagining, previous experiences, knowledge, and dreams (Isabelle, 2007).

No matter how often a student encounters a topic throughout his or her life, he or she may not have relevant acquisitions. However, a student remembers a story for a long time when he or she makes sense of it (Coskun, 2013). Thus, stories provide students with a framework for the formation and persistence of concepts (Demircioglu et al., 2006; Isabelle, 2007).

Stories not only inform listeners but also have the

power to change them. They also promote interactions between teachers and students that ordinary lessons and activities fail to achieve (Balakrishnan, 2008). Teaching through stories makes students' learning meaningful, contributes to students' taking more responsibility for their own learning, fosters students' willingness to learn and helps to achieve meaningful learning (Demircioglu et al., 2006). Stories are also a unique and powerful way to communicate with people. Students need multiple methods to understand abstract mathematical concepts. In this regard, stories are an educational tool that can help students to learn mathematics that they need (Goral and Gnadinger, 2006).

Storytelling serves both cognitive and affective purposes. Cognitively, students establish connections with previous knowledge and create new knowledge. Thus, storytelling is used as a memory reinforcement tool to help students to transfer stored knowledge to new situations. As for affective benefits, storytelling enlightens and entertains students. Storytelling helps teachers, who serve as a representative and facilitator of meaning creation in the classroom, to fulfill their critical tasks. Through storytelling, educators can focus on strengthening students' skills in the classroom setting, helping them to better understand subjects. Storytelling helps students to organize their knowledge, store it in their minds and then recall them. Storytelling can be used in the classroom setting as an excellent method to present information, to support information with facts and evidence, and to encourage discussions on subjects (Shirley, 2005).

Previous research usually involves a comparison of the storytelling method and other methods for the teaching of various subjects. And there are several experimental studies involving various grade levels and analyzing the teaching of social studies, history, religious culture, science, and mathematics through storytelling.

Gulten and Gulten (2004), Balakrishnan (2008), Kir and Tarim (2011), Albool (2012), Coskun (2013) and Sertsoz and Temur (2017) investigated the use of stories in mathematics teaching. The storytelling method has been reported to have positive effects on learning (Coskun, 2013). Relevant experimental research has reported that the achievement of students taught through stories relatively increased compared to those taught using classical methods or existing curricula (Gulten and Gulten, 2004; Albool, 2012; Coskun, 2013; Sertsoz and Temur, 2017).

However, Kir and Tarim (2011) noted that mathematics teaching through stories did not lead to a high level of academic achievement. On the other hand, teaching through stories was found to promote the retention of learning (Gulten and Gulten, 2004). Research reported that students remained interested throughout the mathematics class taught through the storytelling method and learned by having fun (Kir and Tarim, 2011; Sertsoz and Temur, 2017). Stories were also found to increase

students' motivation for mathematics (Albool, 2012).

However, Coskun (2013) found no clear differences between the storytelling method and other existing methods in terms of helping to love mathematics and developing a positive attitude towards mathematics. On the other hand, a story used in mathematics teaching was reported to enhance the ability to understand concepts and the ability to solve mathematical problems (Albool, 2012). Kir and Tarim (2011) suggested that it is more useful to extend storytelling method over a certain period of time and use it occasionally in order to relieve the boredom of the process.

Balakrishnan (2008) noted that stories facilitate generalizing mathematical ideas, presenting mathematical ideas from a different perspective, supporting mathematical ideas as they help students to see great ideas and look for links between story elements and the real life. The author further emphasized that storytelling is a natural way for students to discover connections with everyday life and associate them with mathematical concepts they learn at school and thus; stories should be carefully generated to enhance students' creativity. There are several studies on the use of the method teaching through stories in classes other than mathematics. A relevant study found that stories are effective in eliminating misconceptions (Ayvaci and Coruhlu, 2009).

Storytelling was reported to provide successful outcomes in students' level of knowledge and comprehension and their total gains for the history subjects in Social Studies classes (Simsek, 2004). Students had a positive attitude towards and a growing interest in historical stories (Simsek, 2006). However, Golcuk (2017) reported that science education supported by stories led to no clear differences in students' creativity and attitudes towards science. According to preschool teachers, stories are an effective source of children's development. As important educational tools for children, story books present examples of real-life events and help children to recognize themselves and their environment and to establish healthy relationships with their environment. They also play an important role in enhancing their ability to perceive and interpret (Bagdas and Demir, 2016).

In line with students' views in Golcuk's (2017) research, science education supported by scientific stories is fun, intriguing, imagination-stimulating, and informative; it also increases curiosity about and interest in science classes, raises students' awareness of events in their surroundings, enhances the comprehension and retention of abstract concepts, gives students a chance to observe science subjects in real-life settings, provides a pleasant and positive learning environment, and allows students to express themselves easily.

Pakdemirli (2011) tried to justify the need for using stories in religion and ethics classes, referring to students' developmental characteristics and learning

theories. She noted that students aged 9 to 12 can make sense of abstract religious concepts through stories and that showing positive examples through stories facilitates the correct formation of religious and moral attitudes among students' aged 13 to 15. She also emphasized that storytelling activities contributed to the promotion of students' motivation and the achievement of acquisitions covered in the religion and ethics curriculum.

The present study is of importance since, within the scope of the study, mathematics education students made stories of mathematics subjects taking into account the level of middle school students and produced an instructional material that can be used in mathematics classes. Additionally, this study is also important as students thoroughly experienced the stages of story generation week by week, reflected on and discussed both their own stories and their friends' stories and had an experience of how to teach various mathematics topics to middle school students.

Thus, as pre-service teachers, mathematics education students reflected on how to help students to concretize abstract mathematical concepts; they also exchanged ideas with friends. Therefore, this study served as a preparation for the teaching profession. A literature review yielded no previous equivalent study. Previous research often involves the effects of stories on students and teachers' views about stories. However, the present study involves a stage-by-stage experience of story generation process and seeking mathematics education students' views. In this regard, the study contributes to the literature.

The purpose of this study is to investigate primary mathematics education students' views about mathematics teaching through stories and the story generation process. To this end, the study attempts to help primary mathematics education students to create stories for teaching middle school students mathematics in accordance with the current mathematics curriculum and to gain experiences through the story generation process. Accordingly, the research question was formulated as follows: "What are the views of 3rd grade primary mathematics education students about mathematics teachings through stories and the story generation process? The research sub-questions are as follows:

- (1) What are the views of students about mathematics teaching through stories?
- (2) What are the views of students about the integration of mathematics teaching through stories into courses?
- (3) What are the views of students about competences that they acquire through story generation process?
- (4) What are the views of students about the effects of mathematics teaching through stories on students' mathematics achievement?
- (5) What are the views of students about their own story generation processes?

(6) What are the views of students about the effects of mathematics teaching through stories on the concretization of mathematics?

(7) What are the views of students about benefits that mathematics teaching through stories offers to students?

METHODOLOGY

Research model

Qualitative research involves an in-depth investigation of a situation to find answers to questions such as why and how (Sozibilir, 2009). It is an approach that mainly focuses on investigating and understating social phenomena in their environment with a theorization-based understanding (Yildirim, 1999). The present study used a case study research design which is an interactive qualitative research design. A case study involves a holistic investigation of factors related to a situation and focuses on how these factors influence or are influenced by this situation (Sozibilir, 2009). Every situation can be better understood in its own context; thus, a case study should analyze a situation in its own context and focus on the reality to investigate social phenomena; results should not be interpreted independently of the context (Yildirim, 1999). Content analysis provides an in-depth analysis of collected data and the formation of non-predetermined themes and dimensions (Sozibilir, 2009). For the purpose of this study, mathematics education students' views about mathematics teaching through stories were analyzed through content analysis and presented under a set of themes and categories using codes representing student views. The data were presented using the themes including common categories created. Thus, the researcher presents the data in a processed form (Yildirim and Simsek, 2011).

The study group

This study was conducted at the Faculty of Education, Kafkas University, located at Turkey's Eastern Anatolia Region in the spring term of the 2016 to 2017 academic year. The study surveyed 12 third-grade students studying primary mathematics education. The study group was selected through convenience sampling which is purposive sampling method in which a sample is selected from a close and accessible case, acquaintance people. This sampling brings speed and practicability to researcher (Yildirim and Simsek, 2008).

Data collection

This research was conducted within the scope of the community service practices course taught under the supervision of one of the researchers. The application took 14 weeks. The participating students were first asked to find out mathematics subjects about which story to tell and to identify relevant acquisitions. They were reminded to consult with each other and think of different subjects instead of writing about the same subjects. Thus, as it was planned, each student generated five stories about various mathematics subjects by the end of the term. After being completed, each story was presented in the classroom, discussed by the lecturer and students, and accordingly revised. A three-hour class was held with the students every week; the students were given the opportunity to present their own stories and evaluate their friends' stories throughout 14 weeks; they were asked to evaluate the stories in terms of content, cohesion and coherence, and the conformity to

acquisitions and to writing rules. Thus, the students were helped to experience the process of writing and evaluating mathematical stories. Additionally, questions about each mathematical story were prepared to measure readers' reading comprehension and included at the end of each story. Then, the students created a book titled "Mathematics Teaching Through Stories" that includes all stories. Finally, the students were given a 7-question opinion form and asked to tell their views about mathematics teaching through stories in general, the integration of mathematics teaching through stories into classes, competences they gain through the story generation process, the effects of mathematics teaching through stories on students' mathematics achievement, their own story generation processes, the effects of mathematics teaching through stories on the concretization of mathematics, and the benefits of mathematics teaching through stories for students.

Data collection tools

A 7-question opinion form was administered to the participating students. The form includes the following questions:

- (1) What are your opinions about mathematics teaching through stories?
- (2) How do you think mathematics teaching through stories should be integrated into courses?
- (3) Tell about competences that the story generation process helped you to gain.
- (4) What effects do you think mathematics teaching through stories has on students' mathematics achievement?
- (5) Tell about your story generation process.
- (6) What effects does mathematics teaching through stories have on the concretization of mathematics?
- (7) What benefits does mathematics teaching through stories offer to students?

Expert opinions on the validity of the opinion form were taken and the opinion form was accordingly given its final shape.

Data analysis

Within the scope of this study conducted with third-grade primary mathematics education students, an opinion form including 7 open-ended questions was designed to seek students' views. Students' responses were analyzed through content analysis. Responses were first divided into categories and themes by the researchers and then presented in tables with percentage and frequency values. Expert opinions were taken for the categorization and thematization of students' responses; the categories and themes were accordingly finalized. The data were coded through dual coding to ensure intercoder reliability. The intercoder reliability was found to be 0.82 through the formula proposed by Miles and Huberman (1994). Accordingly, students' opinion forms were first shared between the researchers and then exchanged for reassessment; the consistency value was thus measured. The consistency value indicates an agreement between the intercoders. The verifiability of the data was ensured through intercoder reliability. In order to verify the transferability of results and to document that the participants reflected their own views, direct quotations of students' views were presented after the explanations of the results of each sub-question. In order to prove credibility, researcher triangulation and expert reviews were used.

RESULTS

Results of the first sub-question

This section includes students' responses to the

Table 1. The distribution of students' responses to the question "What are your opinions about mathematics teaching through stories?" according to themes and categories

Themes	Categories	Frequency	Percentage
Academic	Making practical	2	16.7
	Easy learning	5	41.7
	Concretization	8	66.7
	Interesting	12	100
	Fun	5	41.7
	Achievement	5	41.7
	Clarity	10	83.3
	Class participation	6	50
	Exploration	2	16.7
Personal	Love for mathematics	4	33.3
	Imagination	4	33.3

questions in the opinion form. Responses were divided into categories and themes, and presented in tables with frequency and percentage values. The distribution of students' responses to the question "What are your opinions about mathematics teaching through stories?" according to themes and categories were shown in Table 1. As seen in Table 1, students' responses to the question "What are your opinions about mathematics teaching through stories?" were divided into two themes including academic and personal. The categories under the academic theme include making practical, easy learning, concretization, interesting, fun, achievement, clarity, class participation, and exploration. The categories under the personal theme include love for mathematics and imagination.

Listed below are examples of students' responses to the question "What are your opinions about mathematics teaching through stories?":

"Imagination develops with math stories. Stories make subjects interesting and attractive. They make learning fun. They bring the principle of clarity."

"It concretizes subjects and makes them interesting. It increases students' participation in classes. It increased achievement."

Results of the second sub-question

The distribution of students' responses to the question "How do you think mathematics teaching through stories should be integrated into courses?" according to themes and categories were shown in Table 2. As seen in Table 2, students' responses to the question "How do you think mathematics teaching through stories should be integrated into courses?" were divided into five themes including visual, mental, physical, social, use in subjects. The categories under the visual theme include video and

technological support. The categories under the mental theme include appealing to thoughts, promoting retention, and reinforcement. The categories under the physical theme include role-playing and drama. The categories under the social theme include associating with everyday life and student engagement. The categories under the use in subjects theme include before subjects and boring subjects. Listed below are examples of students' responses to the question "How do you think mathematics teaching through stories should be integrated into courses?":

"Visually supporting stories helps students to imagine in their minds. If we include students in stories, then they have higher motivation for the class."

"It promotes retention and it can be integrated through in-class role-playing and drama techniques."

Results of the third sub-question

The distribution of students' responses to the item "Tell about competences that the story generation process helped you to gain" according to themes and categories were shown in Table 3. As seen in Table 3, students' responses to the item "Tell about competences that the story generation process helped you to gain" were divided into two themes including academic and personal. The categories under the academic theme include acquisitions, concretization, and combining mathematics with stories. The categories under the personal theme include level-setting, empathy, creativity, and strength of expression. Listed below are examples of students' responses to the item "Tell about competences that the story generation process helped you to gain":

"It develops the ability to establish empathy. It allows a

Table 2. The distribution of students' responses to the question "How do you think mathematics teaching through stories should be integrated into courses?" according to themes and categories.

Themes	Categories	Frequency	Percentage
Visual	Video	2	16.7
	Technological support	2	16.7
Mental	Appealing to thoughts	3	25
	Promoting retention	8	66.7
	Reinforcement	7	58.3
Physical	Role-playing	7	58.3
	Drama	3	25
Social	Associating with everyday life	9	75
	Student engagement	9	75
Use in subjects	Before subjects	2	16.7
	Boring subjects	4	33.3

Table 3. The distribution of students' responses to the item "tell about competences that the story generation process helped you to gain" according to themes and categories.

Themes	Categories	Frequency	Percentage
Academic	Acquisitions	4	33.3
	Concretization	5	41.7
	Combining mathematics with stories	3	25
Personal	Level-setting	12	100
	Empathy	12	100
	Creativity	10	83.3
	Strength of expression	4	33.3

teacher to develop a perspective similar to students' perspective."

"In this process, we developed empathy with students and act according to their thoughts. The language we used in the stories was chosen as a language that would not be difficult to read, which helped us get down to their level."

Results of the fourth sub-question

The distribution of students' responses to the question "What effects do you think mathematics teaching through stories has on students' mathematics achievement?" according to themes and categories are shown in Table 4. As seen in Table 4, students' responses to the question "What effects do you think mathematics teaching through stories has on students' mathematics achievement?" were collected under one theme as

academic. The categories under the academic theme include willingness, facilitating the process, perspective on mathematics, reinforcement, connection with daily life, retention, subject integrity, and problem-solving skill. Listed below are examples of students' responses to the question "What effects do you think mathematics teaching through stories has on students' mathematics achievement?":

"As stories promote memorability, they facilitate learning mathematics and increase willingness to learn mathematics. Thus, they have positive effects."

"As stories concretize, students better understand and comprehend. They foster students' problem-solving skills. It provides subject integrity."

Results of the fifth sub-question

The distribution of students' responses to the item "Tell

Table 4. The distribution of students' responses to the question "What effects do you think mathematics teaching through stories has on students' mathematics achievement?" according to themes and categories.

Themes	Categories	Frequency	Percentage
Academic	Willingness	6	50
	Facilitating the process	10	83.3
	Perspective on mathematics	5	41.7
	Reinforcement	6	50
	Connection with daily life	7	58.3
	Retention	9	75
	Subject integrity	4	33.3
	Problem-solving skill	7	58.3

Table 5. The distribution of students' responses to the item "Tell us about your story generation process" according to themes and categories.

Themes	Categories	Frequency	Percentage
Introduction	Subject selection	6	50
	Acquisition selection	8	66.7
	Use of expressions	4	33.3
	Teaching through invention	6	50
	Teaching plan	8	66.7
	Pre-learning	6	50
	Interdisciplinary	7	58.3
	Use of imagination	10	83.3
	Putting yourself in students' place	9	75
	Body	Digitize	10
Writing style		6	50
Use of pictures		7	58.3
Discussion of stories		11	91.7
Producing questions		9	75
Conclusion	Headlining	8	66.7
	Converting to a book	10	83.3

us about your story generation process" according to themes and categories were shown in Table 5. As seen in Table 5, students' responses to the item "Tell us about your story generation process" was divided into introduction, body and conclusion themes. The categories under the introduction theme include subject selection, acquisition selection, use of expressions, teaching through invention, teaching plan, pre-learning, interdisciplinary, use of imagination, and putting yourself in students' place. The categories under the body theme include digitize, writing style, use of pictures, discussion of stories, producing questions, and headlining. The category under the body theme is converting to a book. Listed below are examples of students' responses to the item "Tell us about your story generation process":

"Subjects were determined. An acquisition for each subject was determined. Stories were created in line with

these acquisitions."

"First, I decided which subject to choose according to students' level. Because students should have the willingness to read. After determining the subject, I decided to what kind of style to select and what expressions to use in this subject. I planned what steps to use and how to give examples as the story would be through invention. I decided which font size, spacing and widths to use. I selected pictures that would not distract attention according to students' level."

Results of the sixth sub-question

The distribution of students' responses to the question "What effects does mathematics teaching through stories have on the concretization of mathematics?" according to themes and categories were shown in Table 6. As seen

Table 6. The distribution of students' responses to the question "What effects does mathematics teaching through stories have on the concretization of mathematics?" according to themes and categories.

Themes	Categories	Frequency	Percentage
Concretization	Understanding abstract and difficult concepts	10	83.3
	Linking to everyday life	10	83.3
	Mental representation	8	66.7
	Visualization	9	75

Table 7. The distribution of students' responses to the question "What benefits does mathematics teaching through stories offer to students?" according to themes and categories.

Themes	Categories	Frequency	Percentage
Personal	Empathy	8	66.7
	Creativity	12	100
Academic	Subject integrity	6	50
	Mental development	10	83.3
	Solving problems	11	91.7
	Retention	12	100
	Concretization of abstract concepts	12	100
	Role-playing	6	50
	Interest in mathematics	12	100
	Making a story of events	8	66.7
	Feeling the necessity of mathematics	7	58.3
	Applying to similar situations	6	50
	Fun mathematics	10	83.3

in Table 6, students' responses to the question "What effects does mathematics teaching through stories have on the concretization of mathematics?" were collected under the concretization theme. The relevant categories include understanding abstract and difficult concepts, linking to everyday life, mental representation, and visualization. Listed below are examples of students' responses to the question "What effects does mathematics teaching through stories have on the concretization of mathematics?":

"It makes subjects interesting and attractive. It facilitates retention through the application of subjects in real life."

"Stories created according to students' age and development help to overcome challenges in the comprehension of abstract and difficult topics. Because students used their imagination and creativity through stories and integrated mathematics learning into real life; this facilitated concretization."

Results of the seventh sub-question

The distribution of students' responses to the question "What benefits does mathematics teaching through

stories offer to students?" according to themes and categories were shown in Table 7. As seen in Table 7, students' responses to the question "What benefits does mathematics teaching through stories offer to students?" were divided into personal and academic themes. The categories under the personal theme include empathy and creativity. The categories under the academic theme include subject integrity, mental development, solving problems, retention, concretization of abstract concepts, role-playing, interest in mathematics, making a story of events, feeling the necessity of mathematics, applying to similar situations, and fun mathematics. Listed below are examples of students' responses to the question "What benefits does mathematics teaching through stories offer to students?":

"Students learn mathematics having fun. When they encounter an event, they create a story in their mind. It improves empathy skills."

"It shows that abstract mathematics subjects can be used in students' lives through stories. Students recognized the need for mathematics by experiencing and adapting stories to their lives. When they face similar situations in their real lives, they learn what they should do so that they can go through it more painlessly and solve problems

they face. Indeed, students see that mathematics they do not care or deem necessary is involved in all areas of life. As they experience while learning, it provides the retention of learning.”

DISCUSSION

In this study, while expressing their views about mathematics teaching through stories, the students focused more on the categories concretization, interesting, clarity and class participation under the academic theme. The categories under the personal theme were equally expressed. The students reported that mathematics teaching through stories makes mathematics teaching more practical, helps students to more easily adapt to (learn) subjects, concretize subjects, arouses students' interest in topics, makes subjects more fun, increases the level of achievement, clarifies subjects, promotes students' participation in classes, helps students to love mathematics, enhances imagination and helps students to explore subjects.

According to the students' views about the integration of mathematics teaching through stories into classes, promoting retention and reinforcement under the mental theme were particularly emphasized, role-playing under the physical theme was particularly emphasized, and associating with everyday life and student engagement under the social theme were particularly emphasized. The expressions under the visual theme were equally emphasized. The students held the following views: the method of mathematics teaching through stories should be used to address students' abstract and concrete ideas, stories can be supported by visual images, students can be included in stories, stories can be used for boring subjects and in association with everyday life, stories can be applied using role-playing and drama, technology can be utilized while telling stories, stories can be used as a means of reinforcement at the end of subjects, stories can be digitized and converted to a video, and relevant stories can be read before teaching a subject.

Considering the students' views about competences that the story generation process helped them to gain, they mostly expressed concretization under the academic theme, while they mostly reported level-setting, empathy, and creativity under the personal theme. The students reported that they were informed of how subject acquisitions, comprehension and expression change by grade level. They tried to develop empathy with students and act in accordance with their viewpoints. The students believe that stories can help them to get down to students' level and to better communicate with students, they learned how to combine mathematics with stories, stories fostered their imagination and creativity, they learned how to teach a subject in more clear and understandable manner, stories promoted their strength

of expression, and stories helped to concretize difficult subjects and render them in a more intelligible form.

Considering the students' views about the effects of mathematics teaching through stories on students' achievement, they primarily focused on facilitating the process, reinforcement, connection with daily life, and retention under the academic theme. The students held the following views: mathematics teaching through stories helps to minimize students' learning difficulties, it increases students' willingness to learn, it makes learning process more easy and productive, the integration of colors and pictures into stories makes learning more fun, students' perspective on mathematics can be changed, it helps students to overcome prejudices about mathematics, it facilitates the reinforcement of subjects, it promotes students' interest in mathematics and thus have positive effects, it helps to make subjects more memorable through the connections with everyday life, students can better understand a mathematics subject by establishing links with everyday life and this subject thus becomes more simple and clear, it helps to learn other subjects when a subject is learned, it ensures subject integrity, it helps students to observe mathematics in real life, and it helps to develop students' problem-solving skills.

According to the students' views about their story generation process, they mostly focused on subject selection, acquisition selection, teaching through invention, teaching plan, pre-learning, interdisciplinary, use of imagination, and putting yourself in students' place under the introduction theme. All expressions under the body and conclusion themes were more generally addressed. The students stated that they started to write when they had an idea, they selected subjects, they decided which expressions to use while telling about their subjects, they planned what to do and what kind of examples to show as it involves teaching through invention, they planned what students would learn at the end of the story, they decided which font size, spacing and widths to use, they selected non-distracting pictures, they determined subject acquisitions, they identified pre-learning components of subject acquisitions, they did interdisciplinary work, they discussed the deficient aspects of stories in the classroom, they digitized their stories and converted to a book, they generated questions about stories, they headlined their stories, they used their imagination to write stories, and they tried to plan how to help students to better understand.

Considering the students' views about the effects of mathematics teaching through stories on the concretization of mathematics, they mainly focused all expression under the concretization theme. The students held the following views: stories can help to overcome problems in understanding abstract and difficult mathematical concepts, the association of mathematics subjects with everyday life through stories facilitates concretization, mathematics teaching through stories

helps students visualize mathematics subjects in their minds, information is made more permanent when supported by visual elements, especially subjects difficult to comprehend can be converted to stories and can thus be concretized, and students can observe and concretize mathematical concepts in stories as stories better clarify subjects.

Considering the students' views about the benefits of mathematics teaching through stories, all expression under the personal and academic themes were highly emphasized. The students reported that abstract concepts can be made usable in real life through mathematics teaching through stories, students can recognize the necessity of mathematics, they can know what to do when they are involved in a situation similar to that in stories, they can more easily solve problems about the subjects included in stories, students' interest in mathematics grows, students observe mathematics in every area of life, they can make a story of events and visualize in their minds, stories facilitate the retention of learning, they foster visual, mathematical and verbal intelligence, they help to learn mathematics by having fun, they provide subject integrity, and stories develop empathy, role-playing skills, imagination, and creativity.

The students stated that mathematics teaching through stories helps students to better adapt to subjects, that is, to more easily learn subjects. Thus, this result is consistent with that of Coskun (2013) and Bagdas and Demir (2016) as it indicates the significant positive effects of teaching through stories on learning. The students also held the view that mathematics teaching through stories increases students' level of achievement. This result runs parallel with previous research results showing that teaching through storytelling increased students' mathematics achievement compared to other methods (Gulten and Gulten, 2004; Simsek, 2004; Pakdemirli, 2011; Albool, 2012; Coskun, 2013; Sertsoz and Temur, 2017).

However, it contradicts with Kir and Tarim's (2011) research. According to the students' views, teaching through stories helps to clarify and concretize especially abstract and difficult subjects and makes mathematics classes more fun and enjoyable; thus, it promotes students' achievement. This result is consistent with those reported by Simsek (2006), Kir and Tarim (2011), Sertsoz and Temur (2017), and Golcuk (2017). The students' expressions including concretization, interesting and fun, class participation, and love for mathematics indicate that stories promote students' motivation for mathematics. Thus, the present study runs parallel with that of Pakdemirli (2011) and Albool (2012). However, it contradicts with that of Coskun (2013) and Golcuk (2017).

The present study also runs parallel with that of Balakrishnan (2008) as it indicated that teaching through stories helps students to explore subjects and develops creativity. It also runs parallel with that of Golcuk (2017)

as it indicated that teaching through stories promotes curiosity and imagination. However, Golcuk (2017) reported no difference in creativity, which contradicts with the result of the present study. According to the students' views, when students are told stories about a set of abstract boring subjects and concepts, it enhances their imagination, helps students to generate stories over time and to establish connections, and eventually promotes their creativity.

The results of the present study are consistent with those reported by Pakdemirli (2011) in terms of stories' appealing to students' thoughts and with those reported by Gulten and Gulten (2004) and Golcuk (2017) in terms of stories' facilitating retention. While the students recommended to use stories before teaching subjects or to teach boring subjects, Kir and Tarim (2011) suggested that it is more helpful to extend stories over a certain period of time and to use them occasionally in order to relieve the boredom of the process. The category associating with everyday life in the present study is consistent with previous research results indicating that storytelling is a natural way for students to look for connections between real life and story elements and to associate them with mathematical concepts they learn at school.

Thus, the present study runs in parallel with the research of Balakrishnan (2008) and Golcuk (2017). It also runs in parallel with the research of Albool (2012) as it revealed that mathematics teaching through stories helps to acquire problem-solving skills. The present study also found that mathematics teaching through stories provides a positive learning environment allowing students to easily express themselves. This result is consistent with that of Golcuk (2017).

In line with what has been discussed so far and based on the results of the present study, the following suggestions are offered:

- (1) Stories generated within the scope of this study can be applied in schools and the extent to which this application is consistent with the students' views can be examined.
- (2) Stories generated within the scope of this study can be read, reviewed and evaluated by in-service teachers in schools and they can also be applied to students and evaluated by students.
- (3) An application similar to the one carried out within the scope of this study can be provided as in-service training to teachers in schools.
- (4) The Ministry of National Education can plan several projects on mathematics teaching through stories or storytelling in mathematics in order to help students develop a positive attitude towards mathematics.
- (5) Mathematics education programs in faculties of education can include an elective course on the generation of mathematical stories for pre-service mathematics teachers to prepare them for mathematics

teaching through stories.

(6) Subjects that are covered in the current mathematics curriculum and particularly considered difficult by students can be identified and various stories can be created about these subjects.

(7) It should be ensured that each student actively participates in the story generation process within the scope of this study, evaluates and reviews each other's stories. Great care should be taken so that each student can be informed of not only the teaching of their own topics and acquisitions but also the teaching of topics and acquisitions selected by others.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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