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ABSTRACT
This case study investigated math and science teachers' perceptions about the use of creative drama during a digital story (DS) creation process for educational purposes. A total of 25 secondary science and math teachers were selected according to criterion sampling strategy to participate in the study. Data were collected through an open-ended questionnaire and unstructured interviews and then analysed through open coding. Study results showed that most of the science and math teachers had positive opinions about the application of creative drama during the DS creation process. Moreover, the teachers indicated a general preference for using creative drama in their classes to capture students' attention or prompt them to think about their stories at such stages of the DS creation process as scenario design and final presentation. Participants also identified potential obstacles in using creative drama during the DS creation process as teachers not having expertise in creative drama, student inexperience and inappropriate physical conditions of schools.

Introduction

Digital stories are tools recommended by scholars to enhance students' success in science and math education (Robin, 2008; Sadık, 2008). However, the literature regarding educational technology reveals many examples of failed contributions of technology to students' learning (Mishra & Koehler, 2006). As a researcher in this field, I recognize the value of successful technology integration in achieving student goals; therefore, I decided to apply the integration of DSs to fields such as science, math and literacy teaching. I concluded that the benefits of DS creation depend on how well the process is managed, as I witnessed students, teacher candidates and teachers experience difficulty creating DSs. Similarly, Sancar-Tokmak, Sürmeli and Özgelen (2014) found that because pre-service science teachers had difficulty writing stories, they could not focus on the DS process. They further indicated that the process requires significant creativity, also increasing its difficulty. To ameliorate certain problems in the DS creation process, other methods may be explored. As a result of discussion with a

colleague and expert, we incorporated creative drama activities into the DS creation process during a research project in which science and math teachers created DSs. The current study investigates the perceptions of those teachers on this applied use of creative drama.

DS creation and creative drama activities in the research project

The research project, Developing Math and Science and Technology Teachers' TPACK through Creation of Digital Stories, included activities combining creative drama and the DS creation process. The project was supported by The Scientific and Technological Research Council of Turkey (TUBITAK). Three creative drama steps were followed during the DS creation process: preparation or warming up, animation and assessment pointed out by Adıgüzel (2014). The first phase, preparation or warming up, included activities focusing on trust, socialization, communication, concentration and movement, with the aim of forming a group dynamics and getting participants ready for the next activities. For example, during a name game described as one of the beginning activities by Rubin and Merrion (2011), participants formed a circle and tried to guess each other's names, which they described using their bodies instead of words. In the next phase, animation, events and topics were developed through improvisation and role-playing. Participants considered their scenarios, sought out colleagues' opinions, enriched their DSs with audio/visual materials and integrated creative drama into the DS creation process. During one such activity, the groups of four visualized the most important points of their DSs with their bodies, creating a single story tableaux. Booth (2005) describes story tableaux as "frozen pictures, or still images created in response to a theme, situation or story" (p. 48). Groups also shared the first half of their DSs, while acting out the conclusions through creative drama. Through another activity, the groups advertised their DSs with creative drama. In the third phase, the products were assessed, and success in meeting educational goals was defined. At the end of the research project, a persuasive activity was also applied. Groups used creative drama to convince their peers to use their DSs in their future classrooms. After each group performance, participants were asked to reflect on the creative drama activities.

Digital storytelling and creative drama

Digital storytelling is described as a creative teaching form by Banaszewski (2005). Meadows (2003) describes it as the process of creating 2–3-min movies by combining images, text, music and other audio. Robin (2008) mentions three types of DSs: personal stories (sharing characters, memorials, experiences or discoveries), historical stories and educational stories. To provide information for educational purposes, the DS process can be used in three ways: (a) with previously created stories, (b) by creating new, content-specific stories and (c) by having students create their own stories, either individually or in groups.

The literature particularly advocates having students create their own DSs. Robin (2006) points out that giving students the opportunity to create their own stories can motivate them and capture their attention during instruction. The DS process may also contribute to the development of students' communication skills by helping them organize ideas, ask questions and explain their thoughts (Robin, 2006). Similarly, Neal (2001) states that DSs can affect the interaction between students and teachers positively and

develop students' empathy skills. Robin (2006) further explains how students gain Internet searching, writing, technology, presentation, problem-solving and assessment skills during the DS creation process. According to Sancar-Tokmak, Surmeli and Ozgelen's (2013) study results, the DS creation process requires students to use creativity, contributing to its development. Moreover, Kajder and Swenson (2004) emphasize creativity in the DS process by summarizing their experience using DSs in their language class: "Effective teaching practices paired with powerful technologies provide student readers and writers with unique experiences to transform their understanding of events, printed texts, words, and images" (p. 46).

Creative drama can make abstract knowledge concrete and develop students' creative thinking skills. According to Köksal Akyol (2003), drama is a learning technique managed by a leader that provides opportunities for students to imagine, simulate their dreams and reflect on their real and imagined lives. Creative drama challenges students to think about and describe their feelings by considering their needs, interests and experiences (Duatepe & Akkuş, 2006). During the creative drama process, activities are applied in a setting defined with respect to learning goals and group dynamics under the management of a teacher (Adıgüzel, 2006).

Using drama in classrooms results in the development of speaking, writing and communication skills, in addition to creativity (Chiriga, 1997). Creative drama can be an alternative framework for the DS creation process by showing students different ways to think about their experiences. The individual who participates in the drama process lives the imagined reality, questioning and analysing the situation while working in groups and becoming part of the process (Başçı & Gündoğdu, 2011). Adıgüzel (2006) explains how participants try to solve problems using previous experiences while simultaneously internalizing experiences that they have not had personally but are acting out.

In the literature, creative drama is suggested as a way to simplify the DS process. In the current study, teachers' perceptions on the use of creative drama during the DS creation process were investigated because teachers play primary roles in the success of educational policy, innovation and strategy. The study examined the following research questions:

(1)   What do science and math teachers think about the use of creative drama during the DS process?
(2)   What do science and math teachers think about how creative drama could be integrated into the DS creation process?
(3)   What do science and math teachers think about the difficulties that could be met while using creative drama in the DS creation process?

Method

The present study applied the case study research method. According to Yin (2003), case study allows researchers to investigate a single aspect of a problem in some depth. Moreover, Bogdan and Biklen (1998) state that single case study design is "a detailed examination of one setting, or a single subject, a single depository of documents, or a particular event" (p. 59). In this study, science and math teachers' opinions about one issue, the use of creative drama during DS creation process, was investigated.

Sample

The sample consisted of 25 teachers: 12 secondary science teachers and 13 secondary math teachers. While the science teachers were evenly distributed between male and female ($n = 6$ for both), 5 of the 13 math teachers were female and 8 were male. The criterion sampling strategy was applied during the study. All teachers selected were also participants of TUBITAK Project 4005, Developing Math and Science and Technology Teachers' TPACK through Creation of Digital Stories, which provided them with exposure to combining creative drama and the DS creation process. Thus, all participants had relevant experience to form opinions about the topic. Four teachers were selected for interviews in line with the criterion sampling strategy based on their fields and years working as teachers. Two of the selected teachers were science and technology teachers; one had been a teacher for 5–10 years, while the other had been a teacher for 15–20 years. The other two interviewees were math teachers, one teacher with experience of 5–10 years and one for 15–20 years.

Instrumentation

In this study, the data were collected through an open-ended questionnaire and unstructured interviews. The questionnaire and interview forms were developed by the researchers and checked by three external experts whose interest fields included both drama and the DS creation process. The questionnaire included five open-ended questions about the thoughts of the math and science teachers on the usage of drama during the DS creation process. These questions were drawn from Yüksel Arslan's (2013) framework of the DS creation process: (a) the starting point of the story, (b) creating the scenario, (c) selecting the audio/visual materials (design and preparation), (d) creating the DSs by combining the audio/visual materials and (e) presenting DSs. The questions asked (a) how to use creative drama, (b) the effects on students of using creative drama during the DS process, (c) reasons for using creative drama in the DS process, (d) where creative drama could be used during the DS process and (e) what difficulties may be faced when using creative drama in the DS process. The open-ended questionnaire form was presented to four experts in educational programming and computer and teaching technologies. These experts assessed the tool for appropriateness to the subject and comprehensibility of instructions, content and the answering system. The form was then revised based on their feedback. The interview form asked the participants how they could use creative drama in the process of creating a DS, and their answers were clarified thoroughly by the researchers to collect their in-depth views on the subject.

Data collection

Data were collected from math and science teachers who were also participants of TUBITAK Project 4005, Developing Math and Science and Technology Teachers' TPACK through Creation of Digital Stories. This project included two weeks of training in which participants created DSs and attended creative drama activities designed to make them think about the creation process. In order to gather mathematics and science teachers' complete perceptions about the use of drama during the DS creation process, the open-ended questionnaire was administered in writing. To support the data obtained from responses, face-to-face interviews were conducted with two math teachers and two science teachers.

Data analysis

In this study, mathematics and science teachers' perceptions about the use of drama during the DS telling process were examined using content analysis. Content analysis is a scientific approach that allows oral, written and other materials to be analysed systematically and objectively (Tavşancıl & Aslan, 2001). It also facilitates the classification of the entities of a study (Büyüköztürk, Kılıç-Çakmak, Akgün, Karadeniz, & Demirel, 2008). According to Yıldırım and Şimşek (2006), the collected data first need to be conceptualized and then organized rationally according to concepts and themes that explain the data. There are five stages to content analysis: processing the qualitative research data acquired by the documents, encoding the data, finding the themes, organizing the codes and themes and describing and interpreting the findings (Yıldırım & Şimşek, 2006). In this study, the open-ended questions in the form determined the theme. Frequencies and percentages connected to the thematic codes are presented as tables below, accompanied by quotes from the participants for further explanation.

Validity issues

During the data collection process, face-to-face interviews were held in order to analyse specific answers to the open-ended questions. Interviews were recorded with a voice recorder and transcribed. Categories of content were arranged by two specialists on content rather than the researchers to ensure reliability.

Ethical issues

Ethical procedures were observed during this research, as participants were informed about the aim and design of the study. Moreover, the personal identities of teachers were protected at all stages of the study, and there were no harmful effects on participants. All teachers volunteered to be involved.

Results

Perceptions on the use of creative drama during the DS creation process

The results of the study showed that the science and math teachers held positive perceptions about the use of creative drama during the DS creation process, which they felt had positive effects on students and teachers. Most teachers pointed out the advantages of using creative drama during the DS creation process, but three mentioned disadvantages in terms of needing extra time since teachers must obey the national curriculum and create lesson plans according to that schedule. The themes that emerged after data analysis are shown in Table 1.

Codes related to the advantages for students from creative drama use during the DS process included capturing attention ($n = 10$), establishing permanent knowledge ($n = 9$), making knowledge concrete ($n = 5$), connecting information nodes ($n = 5$), enhancing self-efficacy ($n = 5$), generating creative ideas ($n = 4$), promoting active participation ($n = 4$), reaching curriculum objectives ($n = 3$) and managing individual learning ($n = 3$). Most of the teachers felt that creative drama effectively helped with and benefitted the DS process. T11 stated: "If we can provide experiences for students, it is much easier to get their attention

Table 1. Science and math teachers' perceptions on the use of creative drama during the DS creation process.

Advantages of using creative drama during DS creation process

In terms of students	Frequency	In terms of teachers	Frequency
Capturing attention	10	Enhancing teacher motivation	8
Permanent knowledge	9	Helping teaching	5
Reaching curriculum objectives	3	Ease classroom management	4
Generating creative ideas	4	Ease the reaching goals	3
Managing their own learning	3	Ease taking attention	2
Concrete knowledge	5		
Connected information nodes	5		
Active participation	4		
Enhancement in self-efficacy	5		

Disadvantages of using creative drama during DS creation process

In terms of teachers			
Causing difficulty in time management			3

Table 2. Categories of creative drama use in line with the steps of the DS creation process.

The starting point of the story	Creating the scenario	Selecting the visual and audio materials (design and preparation)	Creating digital stories by combining visual and audio materials	Presenting digital stories:
Concretization ($n=5$)	Thinking about scenario through improvisation ($n=9$)	Thinking imagination ($n=4$)	Not used	Concretization ($n=5$)
Taking attention ($n=4$)		Thinking through improvisation ($n=5$)		Summarizing ($n=9$)
				Assessment ($n=3$)

and make students concentrate on the topic. During the DS creation, we can attract students' attention to the topic through experiences". Advantages for teachers with regard to using creative drama during DS creation included enhancing motivation ($n = 8$), facilitating teaching ($n = 5$), improving classroom management ($n = 5$), reaching goals easily ($n = 3$) and capturing students' attention ($n = 2$). In regard to most frequently mentioned advantage, enhancing teachers' motivation, T25 said, "We teachers mostly applied traditional teaching strategies. Creative drama and DS are different than traditional strategies. These strategies are motivating us because we are also learn with students while applying these strategies". Teachers also reported that creative drama use facilitated teaching during DS creation. T4 observed, "Creative drama prompts us to create a climate in which students live the stories. So, the DS creation process becomes much more meaningful and easy. In other word, teaching is much easier".

The pre-service science and math teachers stated they could use creative drama at every stage of DS creation, except when combining audio/visual materials (see Table 2).

As shown in Table 2, the science and math teachers pointed out that they could apply creative drama to make knowledge concrete for students and capture their attention during the first stage, the starting point of the story. Moreover, teachers stated that in the stages of creating the scenario and selecting audio-visual materials, creative drama could direct students to improvise and imagine the scenario. No teachers considered using creative drama while creating the DS by combining audio-visual materials. The science and math teachers emphasized that they would use creative drama during DS presentations to summarize knowledge, assess students and make knowledge concrete.

The interview results supported the open-ended questionnaire. The interviewed teachers described how they could benefit from creative drama during the DS stages by describing activities that combine the two methods. Mathematics teacher T5 explained, "After the topics are selected and groups are formed, I may request from group members to make painting activity by using their bodies to take their attention". Similarly, science teacher T3 stated, "I want students to create a photo frame about the topic selected by using creative drama". Mathematics teacher T25 suggested some benefits of using creative drama during scenario creation:

> For example, we select the topic whole numbers. I can give students 10 min to perform a scenario with their groups through improvisation. They can act as people in an elevator. They can be on the ground floor and then they can go upstairs, for example,+2 Floor, or downstairs, for example −2 floor. Of course, it should be pointed out that the downstairs and upstairs can have unlimited numbers of floors. So, creative drama can help students to think about the DS scenario.

The science and math teachers mentioned different methods for creative drama during DS creation while selecting audio-visual materials. Math teachers wanted to use creative drama to spark students' imagination, but science teachers preferred improvisation. Math teacher T25 stated:

> Design means, first, imagine for me. Students should first imagine what was created. In this step, I used creative drama to make student think through imagination. I want them to close their eyes and imagine the visuals and audio of the story.

Meanwhile, T19, a science teacher, indicated:

> I believe that in the design step, the students should think about the materials which can be suitable to their story. We provide this through creative drama.

During DS presentations, the math teachers stated that they could use creative drama to make abstract concepts in the DS concrete, while science teachers stated that they could use creative drama to assess students' learning and summarize the lesson. T25 expressed, "After the DS presentation, some concepts may remain abstract for students. These concepts may be made concrete, thanks to the creative drama".

Preferences on the integration of creative drama in the DS creation process

When the science and math teachers explained their preferences on the use of creative drama during DS creation, 18 teachers preferred to use creative drama during story creation, and 7 preferred to use it during DS presentations (see Table 3).

Table 3 shows that 11 science and math teachers preferred to use creative drama to get students' attention during the DS creation activity. Ö2 stated, "We teachers suffer from

Table 3. Science and math teachers' creative drama preferences during the DS creation process.

Themes and categories	Frequency
Scenario creation	
Taking attention	11
Giving idea	4
Explain through experiences	3
Presentation of DS	
Repeating topic	1
Better learning and practicing	4
Explain through experiences	3

not capturing the attention of students. I would use creative drama before the DS creation to get students' attention". Moreover, teachers felt that creative drama activities could give students ideas about scenarios, which could be explained through creative drama as well. Seven science and math teachers stated that they would prefer to use creative drama during DS presentations for students to learn the topic better through practical experience and by explaining their ideas. Finally, T21 discussed the potential for reinforced learning: "During DS presentation, creative drama may provide an opportunity to repeat the topics".

Difficulties faced while using creative drama in the DS creation process

The third research question of the study considered the challenges of using creative drama in the DS creation process. Several themes emerged during analysis: teachers not having expertise in creative drama, time limitations, student inexperience, creativity requirements, infrastructure problems, inadequate materials and classroom size (see Table 4).

Participants felt that teachers should have expertise in creative drama to apply this method successfully. T22 stated:

> Drama provided opportunity for experience-based learning. However, I think that teachers do not expertise in this method. We know what drama is, but that is all. We do not know how to apply it, its strategies, and what should be paid attention to during its application. We need an in-service training about creative drama.

The teachers also saw time limitations as a problem. The mandatory national programme has many topics, so they cannot consider the application of time-consuming methods like creative drama and DS creation. They pointed out that they can apply constructivist instructional methods such as problem- or project-based learning limitedly, despite the national math programme being based on constructivism. Creative drama and DS creation empower students to manage their own learning, as suggested in the constructivist philosophy, but they take too much time to implement according to study participants. Students' inexperience in applying both methods could also be a problem from the teachers' perspectives. Moreover, both methods require creativity, and since both teachers and students are accustomed to traditional instruction based on lecture and practice, they could struggle to create activities and apply them, according to the teachers. Some teachers pointed out that problems related to schools' physical conditions could cause problems with both methods. For example, most schools do not have designated drama facilities or appropriate classroom materials. Finally, teachers stated that crowded classrooms can make it difficult to incorporate creative drama. T22 stated:

Table 4. Potential difficulties faced by math and science teachers while using creative drama in the DS creation process.

Themes	Frequency
Teachers not having expertise in creative drama	7
Time limitation	6
Students' inexperience	5
Requiring creativity	4
Inappropriate physical conditions of schools	3
Inadequate materials	3
Classroom size	3

> Drama is one of the most important methods of providing learning to students. However, drama practices are difficult in crowded classrooms. Because the number of students in these classes is more, mobility of students is limited.

In sum, the results of the study showed that science and math teachers have positive opinions about the application of creative drama during the DS creation process. They thought that creative drama could provide many advantages both for students, such as capturing their attention, making knowledge permanent and concrete, accomplishing curriculum objectives, managing their own learning, creating ideas, enhancing self-efficacy, increasing active participation in lessons and connecting information nodes, and for teachers, such as enhancing motivation, facilitating teaching, improving classroom management, achieving goals and capturing students' attention with ease. Moreover, results showed that teachers generally preferred to use creative drama to capture students' attention or prompt their thinking about the DS that they would create. Mostly, they preferred to use creative drama at the stages of scenario creation and DS presentation. Finally, the teachers expressed potential difficulty in using creative drama during the DS creation process due to teachers not having expertise in creative drama, time limitations, student inexperience, creativity requirements, inappropriate physical conditions of schools, inadequate materials and classroom size.

Discussion and conclusion

This descriptive case study investigated math and science teachers' perceptions about the use of creative drama during the DS creation process. A total of 25 secondary science and math teachers participated in the study. All participants were selected according to the criterion sampling strategy in that they were all participants of TUBITAK Project 4005. Under the scope of this project, the math and science teachers participated in two weeks of in-service training in which they created DSs and attended creative drama activities during the DS creation process. Because the project provided this experience, the population sample had first-hand knowledge about how creative drama could be used during DS creation. The data were collected through an open-ended questionnaire and unstructured interviews and analysed through open coding. The study had three research questions related to teachers' perceptions of (a) the overall use of creative drama during the DS creation process, (b) the specific integration of creative drama into the DS creation process and (c) difficulties teachers might face while using creative drama in DS creation.

The results showed that most of the math and science teachers had positive perceptions on the use of creative drama during the DS creation process, noting advantages for both students and teachers. In terms of students, creative drama use provided benefits such as capturing attention ($n = 10$), making knowledge permanent ($n = 9$), making knowledge concrete ($n = 5$), connecting information nodes ($n = 5$), enhancing self-efficacy ($n = 5$), creating ideas ($n = 4$), increasing active participation ($n = 4$), reaching curriculum objectives ($n = 3$) and managing individual learning ($n = 3$). For teachers, the DS creation process aligned with advantages provided by creative drama such as enhancing motivation ($n = 8$), facilitating teaching ($n = 5$), improving classroom management ($n = 5$), reaching goals more easily ($n = 3$) and capturing student attention with ease ($n = 2$). The only disadvantages pointed out by the math and science teachers on the use of creative drama during DS creation was difficulty in time management. According to Henkel (2002), creative drama provides an opportunity

for students to feel freedom and be entertained during lessons, in addition to sparking creative ideas on a topic. The teachers in the current study pointed out parallel ideas, mentioning how students could create ideas and actively participate in lessons. Ultimately, participants felt that applying creative drama can make the DS creation process easier.

According to the math and science teachers, creative drama could be used during all stages of the DS creation process – the starting point of the story, creating the scenario, selecting the audio-visual materials (design and preparation) and presenting the DSs – except for the combining of audio-visual materials. Participants indicated that creative drama could be used to capture students' attention, encourage their thinking about the related DS creation stages, assess their learning and summarize the lesson. Moreover, according to the results, the teachers believed that using improvisation and imagination during creative drama activities made knowledge concrete, which parallels the literature. Young and Kellogg (1993) and Maden (2010) state that drama is a way to provide concrete experiences for learners. Baldwin (2009) further asserts that learners are physically and mentally active during creative drama activities. During interviews, the teachers stated that they could use photo frame and canvas-painting activities of creative drama during the first stage, the starting point of the story. These examples are similar to two activities conducted during in-service training under the scope of TUBITAK Project 4005, known as frozen image and movement study using the body. Therefore, the teachers' opinions may have been affected by the creative drama activities applied during their in-service training. The math and science teachers most preferred to use creative drama during scenario creation and DS presentation, when it could be used to capture students' attention, give them ideas and explain their experiences. Sancar Tokmak et al.'s (2014) study showed that pre-service teachers mostly had difficulty during the story creation stage. Similarly, teachers had experienced difficulties related to story creation during the in-service training under the TUBITAK project (TUBITAK report).

The results of the study showed that math and science teachers emphasized possible difficulties related to teachers not having expertise in creative drama, time limitations, student inexperience, creativity requirements, inappropriate physical conditions of schools, inadequate materials and classroom size. O'Neill and Lambert (1987) posit that teachers should have expertise or competencies in creative drama to apply this method successfully for learning, which was the most emphasized potential challenge by participants. Creative drama is compatible with the constructivist philosophy (Bertiz, Bahar, & Yeğen, 2010), so the difficulties addressed by the teachers with respect to creative drama application should be among the issues taken into account by the country's policies.

Overall, results showed that, from the math and science teachers' perspectives, creative drama might make the DS creation process easier. However, this study had a limitation related to real classroom applications. Therefore, to reach a complete understanding about the use of creative drama during the DS creation process, future research should investigate such real classroom applications. These studies could examine how the creative drama was applied, what difficulties were faced during the application and whether creative drama aided the DS creation process.

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