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Preservice Mathematics Teachers' Perceptions of Drama Based Instruction

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The purpose of this study was to determine the perceptions of pre-service mathematics teachers related to drama-based instruction. For this purpose, effects of a drama-based mathematics course on senior class pre-service mathematics teachers' knowledge about drama-based instruction and teacher candidates' competencies for developing and implementing drama-based lesson plans were investigated. Participants of the study were 21 senior class pre-service mathematics teachers of a public university in Turkey. Data were collected through an open-ended evaluation form, lesson plans and self-assessment reports. After the 11-week implementation of drama-based activities with teacher candidates, pre-service mathematics teachers succeeded to develop unique lesson plans and implement them with pupils. Lesson plans and self-assessment reports of teacher candidates were analyzed according to descriptive and content analysis. Findings were discussed according to the emergent categories.

Keywords: drama-based instruction, perceptions of teacher candidates, mathematics teaching

INTRODUCTION

Considering the twenty-first century's conditions, student-centered and constructivist learning environments have become significant. As a result, teachers need to design their instruction grounded on student-centered instructional strategies. Recent studies have shown that teachers need to have a repertoire of student-centered and process-oriented teaching methods and a deeper understanding about the in-class implementations of these methods (Hashweh, 1996; Niess, 2005; Orlich, Harder, Callahan, Trevisan, & Brown, 2012; Sullivan & Glanz, 2005). Research in the educational field has made a wide range of student-centered methods available for teachers (e.g. cooperative learning, active learning, project based learning, drama). As a student-centered and process-oriented teaching method, drama excites the attention of researchers especially in social sciences and science education. Many research findings have shown that drama is an effective instructional method (Duatepe-Paksu & Ubuz, 2009; Heathcote & Bolton, 1995), leads to higher performance of students cognitive (Duatepe & Ubuz, 2009; Batdı & Batdı, 2015;

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Kardash & Wright, 1987; Taşkın-Can, 2013) and affective development (Freeman, Sullivan, & Fulton, 2003; Necco, Wilson, & Scheidemantel, 1982; Yau, 1992).

Drama is an art form and empirical learning process in which people improvise, role-play and so on in order to explore problems and seek solutions. Pinciotti (1993) defined drama as a specific type of learning activity which is guided by a leader and gives chance to participants to imagine, enact and reflect upon the human experiences. Drama is usually combined with other curriculum areas, which is why drama lessons are curricular related (Heinig, 1988).

NCTM (2000), MoNE (2006, 2013) emphasized the student-centered learning environment with the intent of actualizing constructivist approach. According to Richards (1996) to understand the subject matter, active engagement in the learning process is crucial. According to socio-cultural theory, students thinking and interpretation progress through the social experiences between peers (Vygotsky, 1978). Throughout the drama activities in a social interactive environment students actively participate to the learning process and construct meaning by role-playing, as if play and improvisations (Wilhelm, 1997). Chilcoat and Ligon (1998) underlined that dramatic activities procure opportunities for group participation, creative expression of personal experiences, building self and collective confidence, constructing contexts in order to promote understanding of lessons, encouraging critical thinking and experiencing with social responsibility. This idea is supported by McCaslin (1990) as drama leads to opportunities for physical, mental, emotional and verbal expressions and children like the act of creating and pretending.

State of the literature

- Drama is an experiential learning process. During drama-based instruction students construct the knowledge throughout the improvisations, dramatic moments and make believe plays.
- Knowledge constructed through drama-based activities becomes an experiential product. Learning environments designed with drama-based activities provide new opportunities for learners toward making sense of concepts.
- In order to meet the twenty-first century's requirements designing student-centered learning environments associated with real life experiences come into prominence. When considered from this point of view, teachers' perceptions related to the instructional techniques come in sight as an important issue.

Contribution of this paper to the literature

- This study employed a qualitative design in order to deeply analyze the progress of mathematics teacher candidates' perceptions related to drama-based instruction.
- The number of the studies related to the usage of drama-based instruction within mathematics lessons are limited. In general teachers do not prefer to use drama-based activities while teaching math concepts.
- Training mathematics teacher candidates towards the usage of drama-based instruction and adapting drama-based instruction into teacher training programs is an opportunity for creating student-centered and real life connected learning environments.

From the perspective of McCaslin (1990), teachers use drama as a teaching technique to gain knowledge, explore problems, seek solutions, draw interest and foster positive attitudes. The classroom teacher must overcome with exploring the tension and conflict, pointing out interest in a topic, collecting relevant source materials, guiding the activities. Another responsibility of the classroom teacher is creating a comfortable, noncritical, nonthreatening atmosphere for participants.

Heinig (1988) considered a drama-based lesson under three phases. The first phase in a drama-based lesson is the warm-up activities, which puts the participants in a relaxed mood and therefore better ready to work together. Generally, warm-up activities include some tips related to the content. In the development phase of the lesson, the main theme of the concept is configured in order to achieve the goals. The lesson ends with cooling-off or quietening-down activities, in which the participants have a chance to review and think about the experience they have just had (Heinig, 1988). All three phases of a drama-based lesson include some drama techniques aimed at reaching the objectives. Selecting the appropriate technique depends on the content, preparedness of the participants, allocated time for the activities and the

physical conditions (Neelands & Goode, 2015). As a leader, the classroom teacher is responsible for determining the required time, effort and drama technique (Heinig, 1988).

Wright (1985) focused on the teacher training programs' incompetency on improvisational procedures. Learning about drama is not sufficient for performing it in the classroom. From her point of view, teachers who have taken some drama training encounter difficulties while putting drama activities into practice, and feel uncomfortable and concerned with the process of drama. In order to overcome these problems, teachers need to be better prepared within the "structured but flexible" improvisation-based situations (p. 205); participate in drama sessions, and prepare and practice drama activities with pupils (p. 206). The aim of the drama activity is not the teaching of drama as an art, the focus should be on teaching the subject matter within the drama process (Adıgüzel, 2012).

The purpose of this current study is to investigate the effects of a drama-based mathematics course on senior class pre-service mathematics teachers' knowledge about drama-based instruction and competencies for implementing drama-based instruction.

Research questions:

1. What do pre-service mathematics teachers know about drama-based instruction before and after a drama-based mathematics course?
2. How does pre-service mathematics teachers' competency affect developing drama-based lesson plans?
3. What are the opinions of pre-service mathematics teachers related to the implementation of drama-based lesson plans with pupils?

METHODOLOGY

Research model

Qualitative study was defined by Fraenkel, Wallen, and Hyun (2006) as a process in which the quality of the situations, activities, materials and relationships are being investigated. Within this current study, it was aimed to identify the effects of drama-based mathematics course on pre-service mathematics teachers' knowledge about drama-based instruction and the competencies required for implementing drama-based learning. To achieve the aims of the study and to provide in-depth information about the situation, the qualitative research model was elected. As a qualitative research design, multiple case study was applied. According to Merriam (1998), case study is used for in-depth understanding of a situation and the meaning of that situation. This current study focused on the process of drama activities in which the pre-service mathematics teachers developed and investigated the meaning of drama processes. In a case study, researchers focus on the process rather than the results and the context, not a specific variable.

Participants

Participants of the study were senior class middle school pre-service mathematics teachers of a public university in a large city in Turkey. Since it would be difficult to undertake the study with all pre-service teachers, this study consisted of 21 middle school pre-service mathematics teachers selected by convenient sampling. Twenty-one students who were voluntarily enrolled to the elective "Drama Applications in Education" course participated in the study. However, as all participants of the study were female, it was not possible to make a comparison regarding gender. None of the participants had any previous drama experience from before the course. Participants of the study took the courses of "instructional principles and methods", "methods of

teaching mathematics-I", and "methods of teaching mathematics-II". Within the contexts of these courses, they learn to apply the methods of teaching elementary school mathematics, understand the processes of instructional planning, prepare and present plans for mathematics instruction which utilize different teaching methods. Instead of using their real names, the pre-service mathematics teachers who participated in this study were coded as PSMT1 (Pre-Service Mathematics Teacher-1) through to PSMT21.

Procedure

The study was implemented during the 2014-2015 spring semester. Objectives towards geometry comprise concrete concepts and it is easier to connect the geometric concepts with real life. As well data topics include many notions concerning everyday life. Consequently, prior to the study drama-based activities on polygons, circle and data analysis topics were developed by the researcher who attended 160 hours of drama workshops given by a creative drama association. Eleven drama-based activities were developed according to the middle school mathematics curriculum objectives suggested by Ministry of National Education (MoNE, 2013).

Eleven weeks (33 lesson hours) of drama activities were administered by the researcher, the instructor of the "Drama Applications in Education" course. During the implementation of drama activities, the instructor was the facilitator; in addition, sometimes she participated in the drama activities by taking on roles in order to guide the participants and foster communication. Participants generally worked in small or large groups to discuss, develop and criticize ideas, to partake in discussions, make calculations and measurements, and to take on roles in the plays.

Lessons were performed in a drama classroom. The classroom was carpeted and there were big pillows to sit on. The physical environment was suitable for group work and provided enough space for physical movement.

After reviewing the related literature (Adıgüzel, 2012; McCaslin, 1990; San, 1996; Üstündağ, 1997), drama-based activities were constructed in three phases; warm-up activities, development activities, and evaluation. At the beginning of the lessons, warm-up activities took place for 3-5 minutes in order to prepare participants for the rest of the lesson. The purpose of the activities (e.g., drawing a flower by using only rectangles) and make-believe plays (e.g., make as if you are in a market and looking for something to buy) within this phase was to make participants relax and ready for group work. Generally an instrumental music was played. The warm-up phase included some clues regarding the objectives of the lesson.

During the development activities the main frame of the lessons was constructed. Participants generally worked in groups or as a whole class. They created, communicated and lived their ideas, made constructions, and improvised concepts related to the objectives. Make-believe plays used for improvisation in the development phase are mostly collaborative and help to create an environment for dramatic moments to achieve the objectives. Drama techniques such as role play, still image, TV program, flashbacks, writing in role, teacher in role and telephone conversation were used within the lesson flow.

The evaluation phase focused on the key concepts of the lesson. Participants summarized the main points by improvisation and using drama techniques such as telephone conversation or writing in role. At the end of each lesson, the researcher and the participants discussed the drama activities and the drama techniques that had been used.

An expert on drama checked the drama-based lesson plans. With respect to her suggestions, some drama techniques were added to the plans and instructions in some lesson plans were changed to add clarity.

Class attendance was mandatory. All PSMTs attended more than 85% of the drama-based lessons.

Data collection and analysis

Open-ended evaluation form

In order to investigate the pre-service mathematics teachers' knowledge about drama-based instruction, an evaluation form that included open-ended questioning was developed by the researcher after reviewing the related literature (Adıgüzel, 2012; Heinig, 1988; Neelands & Goode, 2015; Üstündağ, 1997; Wright, 1985). The evaluation form was including 6 questions, focused on the basic concepts (definition of drama, phases of drama based instruction) and key components of drama-based instruction (drama-techniques, dramatic moments) and implementation of drama-based learning in mathematics lessons (drama as an instructional technique for teaching mathematics, lesson planning). The PSMTs were asked to give unique examples for drama usage in mathematics classrooms. PSMTs provided written responses to the questions.

To ensure validity of the assessment tool, the evaluation form was checked by two experts on drama-based education, and based on their suggestions, modifications were applied. At the beginning of the "Drama Applications in Education" course, and before the treatment, the form was administered to the participants. Then, at the end of the semester, the evaluation form was administered again to the participants.

To identify the effects of a drama-based mathematics course on senior class pre-service mathematics teachers' competencies for developing and implementing drama-based learning document analysis (lesson plans and self-assessment reports of PSMTs') was used.

Lesson plans

At the end of the semester, the PSMTs were asked to develop a unique lesson plan related to mathematics curriculum (Grades 5-8) considering the drama-based instruction. The lesson plans of the PSMTs were analyzed according to descriptive analysis by considering the phases of drama-based instruction (warm-up, development, evaluation) and usage of key components of drama-based learning (drama techniques, make-believe play, dramatic moments).

Self-assessment reports

In order to identify the perceptions of PSMTs about the usage of drama-based instruction, to refer their suggestions related to the implementation process and to evaluate the process from the view point of PSMTs, they were asked to write self-assessment reports after implementing their lesson plans with pupils. PSMTs' implemented their lesson plans in due course of teaching practice. Each PSMT implemented the drama-based activities at their own training schools. All practice schools were public middle schools. The self-assessment reports focused on the strengths and weaknesses of the implementation process. Students written responses were analyzed according to content analysis. Themes were identified in order to obtain more explanatory results.

In this research the author and an associate professor who conducted research on drama-based learning evaluated 21 lesson plans according to the predetermined themes and self-assessment reports with the intent of establishing themes. For testing the agreement between coders, "reliability=number of agreements/ (total number of agreements+disagreeements)" formula suggested by Miles & Huberman (1994) was used. According to Miles & Huberman (1994), reliability values greater than 70% is preferable. For lesson plans intercoder reliability was 92.4% and for self-assessment reports 90.8%. The author of the study also re-coded the 21 lesson plans and self-

assessment reports 6 weeks later the first coding and calculated the agreement between first and second assessments as 98.3% and 95.7%, respectively.

FINDINGS AND RESULTS

1) This section reports on the findings related to the research question "What do pre-service mathematics teachers know about drama-based instruction before and after a drama-based mathematics course?", and includes initial and final assessment findings related to the open-ended evaluation form responses of the PSMTs.

Findings related to the definition of drama-based instruction

According to the participants' responses to the question: "What is drama-based instruction?" in the initial assessment, none of the PSMTs could properly define the formal definition of drama-based instruction. PSMTs responses to the first question connected to the initial assessment are shown in Table 1. Some of the PSMTs used more than one response while defining the drama-based instruction.

On the other hand, regarding the final assessment, according to the participants' responses to the "What is drama-based instruction?" question, 12 of the PSMTs defined the drama-based instruction correctly by considering all components. Six PSMTs focused on the learning process and defined drama-based instruction as "learning through experiencing", however the usage of drama and its key components are missing in this definition. PSMTs responses to the first question were given in Table 2.

Findings related to the drama techniques

In the initial assessment, regarding the participants' responses to the question "Give examples for drama techniques and explain them", only one PSMT gave an example for drama techniques as "role play", although she could not explain it in detail. Twenty of the PSMTs were unable to give any examples for drama techniques in the initial assessment.

Regarding to the participants' responses to the question "Give examples of drama techniques and explain them" in final assessment, all the PSMTs gave at least three examples of drama techniques and explained the usage of this techniques within drama-based instruction in some detail. Table 3 shows the number of drama techniques explained by the PSMTs.

Table 1. Initial assessment results related to the definition of drama-based instruction

PSMTs' Responses	Frequency
Theatre	7
Animating	6
Improvisation	5
Play	5
Empathize	2
Gestures & facial expressions	1
Expressing feelings	2
Creativity	2

Table 2. Final assessment results of the definition of drama-based instruction

PSMTs' Responses	Frequency
Correct definition	12
Learning through experiences	6
Improvisation	1
Creative role-playing activity	2

Table 3. Knowledge of drama techniques

Drama techniques	Frequency (Number of PSMTs)
Still image, role play, teacher in role (or improvisation)	11
Still image, role play, improvisation, writing letters (or teacher in role)	6
Still image, role play, teacher in role, writing letters, improvisation (or telephone conversation)	3
Still image, role play, teacher in role, writing letters, improvisation, telephone conversation, role cards	1

Table 4. Usage of drama- based instruction in educational disciplines

PSMTs' Responses	Frequency
Every discipline	7
Only in verbal lessons (Turkish, English, Social Studies)	7
Only in mathematics lessons	4
Mathematics and verbal lessons	2
No idea	1

Findings related to the usage of drama-based instruction in education

According to the participants' responses to the question: "For which lessons drama-based instruction can be used?" in the initial assessment, seven of the PSMTs stated that this method can be used for teaching all lessons. Seven of the PSMTs mentioned that drama-based instruction can be used only in verbal lessons such as Turkish, English and Social Studies. On the other hand, four of the participants found drama-based instruction usable in mathematics lessons and two participants expressed that drama-based instruction can be used both in verbal lessons and in mathematics. Findings were shown in Table 4.

In the initial assessment PSMTs were asked to give examples for the usage of drama-based instruction in mathematics lessons. Although, seven of the PSMTs stated that drama-based instruction can be used in every discipline and six emphasized the usage of drama-based instruction in mathematics lessons, 19 of the PSMTs could not give any example for the usage of drama-based instruction within mathematics lessons. Two of the PSMTs' drama-based instruction examples were considered unsuitable. The lesson plans do not include the phases of drama-based instruction, drama techniques and dramatic moments.

When we take a glance at the final assessment responses of PSMTs concerning the same questions, all PSMTs stated that drama-based instruction method can be used for teaching all lessons, stating it is especially helpful for concretizing abstract concepts in mathematics. Related to their final assessment responses, the PSMTs were asked to give examples for the usage of drama-based instruction in mathematics lessons. All PSMTs were able to give an example of drama-based instruction towards mathematics teaching in middle schools, including the phases of drama-based instruction (warm-up, development, and evaluation), drama techniques and dramatic moment(s).

Findings related to the competency perceptions of PSMTs

"Do you think that you can implement drama-based instruction in your mathematics lessons with pupils?" were asked in initial assessment to the participants. Only one participant expressed that she could implement drama-based instruction in her mathematics lessons with pupils, however 20 PSMTs stated that they could not. However in the final assessment, all the PSMTs emphasized that after taking the "Drama Applications in Education" course they are disposed to use drama-based instruction for teaching mathematics. Nineteen PSMTs stated that they can implement drama-based instruction in their mathematics lessons with pupils. Besides, two of the PSMTs expressed that they need to gain further experience for

implementing drama-based instruction in-class training. Participants of the study mentioned that unless they attended a drama-based course within their undergraduate study, they will not use drama-based instruction as a teaching method during teaching profession. *PSMT-11:"I was enthusiastic about using drama-based instruction, but before taking this course I was not able to develop lesson plans and implement them in the classroom".* Some of the PSMTs emphasized that attending a drama-based learning course and learning about its key components added value for designing drama-based lessons. *PSMT-5:"Before taking the drama applications in education course it was impossible for me to design a drama-based lesson". PSMT-10:"I was not aware of drama-based instruction as a teaching method before attending this course". PSMT-18:"In my opinion, planning drama-based mathematics lessons without taking any training is not possible".* Additionally, some of the PSMTs considered the practical course process significant. *PSMT-16:"I cannot teach in a way that I don't know or experienced".*

2) Findings related to the research question: "How does the pre-service mathematics teachers' competency affect developing drama-based lesson plans?" are shown below.

In order to explain the findings related to the second research question, the PSMTs' lesson plans were analyzed according to the descriptive analysis with respect to 2 themes: (a) phases (warm-up, development, evaluation) and (b) key components (dramatic moments, make-believe plays, drama techniques) of drama-based instruction.

According to Table 5, different learning domains and different grade levels were chosen by the PSMTs for the developing of lesson plans. After all, eight plans belong to 7th Grade and eight plans belongs to 8th Grade, with the number of lesson plans for 5th Grade and 6th Grade less than the other grades. When we take a glance at the learning domains, plurality of PSMTs preferred the "numbers and operation" (five plans) and "geometry and measurement" (15 plans) learning domains. Twenty-one of the PSMTs' lesson plans were analyzed by two experts on drama-based instruction, in terms of phases of drama-based instruction. Besides, a mathematics educator from a public university examined the lesson plans regarding the 5th-8th Grades mathematics curriculum objectives. Randomly selected, 10 drama-based lesson plans' analysis according to phases of drama-based instruction are shown in Table 6.

Analysis of the lesson plans showed that the PSMTs properly applied the phases of drama-based instruction to the development of the lesson plans. When we look at the lesson plans, all three phases were connected to each other in a logical framework. Lesson plans contributed to both reaching the objectives related to the topic and the drama-based instruction.

Warm-up activities of the lesson plans developed by the PSMTs included some hidden clues related to the topic. PSMTs overcame with warm-up activities by using improvisations, imaginations and plays, and the content of these were not disconnected with the context. For example; PSMT-15 started her activity with an imagination of snowflakes in order to teach fractals. The construct of snowflakes include some clues related to the fractal concept. On the other hand, PSMT-11 adapted

Table 5. Number of lesson plans prepared by PSMTs (grade levels and learning domains)

Grade Level	Learning Domain				
	Numbers & Operations	**Algebra**	**Geometry & Measurement**	**Data Processing**	**Probability**
5	2	-	-	-	-
6	1	-	2	-	-
7	2	-	6	-	-
8	-	-	7	-	1

Table 6. Analysis of lesson plans in terms of the phases of drama-based instruction

PSMT	Topic	Warm-up Phase	Development Phase	Evaluation Phase
2	Percentages	Walking as if going window-shopping, counting by twenty each	Improvisations in groups in order to portray a shopping process (by using percentages)	Sharing thoughts related to the concept of percentages, writing letters in groups to a former classmate and telling about the activity
4	Congruency, similarity	A play named "polygon basket"	Working in groups as if they were architects in order to construct congruent and similar polygons	Discussing the properties of congruent and similar polygons in a whole-group improvisation
7	Circle	Walking around and drawing circles by using body parts	Making an improvisation about the arrangement of trees around a fountain (relates to the circle concept)	Discussing the properties of circles with the whole group
8	Fractions	Painting figures related to fractions	Improvisations of a story related to fractions and fraction operations	Making telephone conversation to explain the concept of fraction to a classmate who was absent from the lesson.
11	Permutation, combination	A play named "musical chairs"	Making improvisations about riding bumper cars (in doubles, threes, fours) at a funfair	Making an improvisation as a reporter interviewing children at a fun fair (for making the connection between permutation-combination concepts and getting on the bumper cars in doubles, threes)
15	Fractals	Imagining snowflakes and observing imaginary snowflakes	Making an improvisation related to the fractals in nature	Discussing the topic in a play
17	Operations with natural numbers	Three plays related to numbers (enumerating, counting but not verbalizing multiples of three, movement of atoms)	Answering questions according to instructions given in a story	Drawing a picture, writing a song or poetry related to the natural numbers
18	Polygons	Designing t-shirt patterns by using polygons	Making improvisations about the polygon shaped houses	Writing letters to an old friend and explaining the properties of polygons
20	Prisms	A play related to the polygon and prism-shaped real life objects	Making improvisations about children in a neighborhood designing and constructing prism-shaped animal shelters	Talking about the properties of prism-shaped animal shelters constructed by children
21	Symmetry	Mirror play peer-to-peer	Making an improvisation related to the symmetric figures on axes of coordinate	Whole class discussion

the famous "musical chairs" play to her warm-up activity in order to teach permutation and combination concepts. The structure of the warm up activities served the purpose of teaching mathematics.

Development activities of lesson plans produced by PSMTs include various drama techniques and took the longest time among the three phases. PSMTs used improvisations during this phase in order to foster meaningful learning through experiencing situations in real life contexts. When we deeply analyzed the development phase activities of PSMTs, it is clear that this phase is well constructed and has strong bonds with the mathematics curriculum objectives.

At the evaluation phase the PSMTs chose alternative evaluation activities such as telephone conversations, improvisations, interviews, whole group discussions and writing letters. All evaluation activities serve for the revision of learning processes in terms of learning outcomes.

On the other hand, PSMTs' lesson plans were analyzed with respect to the key components of drama-based instruction such as make-believe plays, dramatic moments and drama techniques. Randomly selected, 10 drama-based lesson plans were analyzed according to the key components of drama-based instruction, as shown in Table 7.

Make-believe plays are one of the main components of improvisation processes. According to Duatepe (2004), make-believe plays function as a bridge between the subject matter and real life experiences in order to improve meaningful learning. All PSMTs used make-believe plays within their lesson plans in order to make real life connections of concepts. The majority of the make-believe plays used by the PSMTs were included in the warm-up and development phases. Duatepe (2004) emphasized that dramatic moments encourage participants to construct knowledge and find essential relations between concepts. However some lesson plans developed by the PSMTs disregarded dramatic moments (6 out of 21), whereas the majority of the plans did include dramatic moments. Drama techniques are the inseparable parts of drama-based lessons. Lesson plans developed by PSMTs were rich in drama-techniques. PSMTs selected the appropriate drama techniques according to the concepts' and pupils' properties.

Table7. Analysis of lesson plans in terms of the key components of drama-based instruction

PSMT	Make-believe play	Dramatic moment	Drama techniques
2	As if the students were people window shopping	Tension while selecting a low-priced product	Role play Improvisation Writing in role
4	As if the students were architects	Overcoming the obstacle of building congruent and similar polygons as architects	Teacher in role Whole group drama
7	As if the students were trees in a jungle	While trying to find a relation between the circumference and radius of the circle, a tension occurs during the improvisation	Role play Still image Improvisation
8	As if the students were a child lost in a jungle and had to find the password	Finding the correct answer of the challenged questions in order to find the way of home	Role play Telephone conversation Improvisation
11	As if the students were children at a funfair about to ride the bumper cars	A tension occurs between children while getting on the bumper cars according to permutation	Role play Interview Improvisation
15	As if the students were fractals in nature	Not included	Role play Still image Improvisation
17	As if the students were moving atoms	A tension occurs while solving the problems in order to find the password	Role play Improvisation Writing in role
18	As if the students were the corners of polygon-shaped houses	A tension occurs during determining the interior angles of polygon-shaped houses	Role play Improvisation Writing in role
20	As if the students were the designers of prism-shaped animal shelters in a neighborhood	A tension occurs while constructing and selecting the appropriate shelters for animals	Role play Improvisation
21	As if the students were the reflection of objects	Not included	Role play Still image

3) Findings related to the opinions of pre-service mathematics teachers regarding the implementation of drama-based lesson plans with pupils.

Preservice teachers wrote a self-assessment report regarding their drama-based instruction experience after implementing lesson plans with pupils. Content analysis was used to analyze the PSMTs' written responses. Data were coded by two experts (the author and an associate professor). The results of the data analysis emerged under 8 categories.

Students' roles, ideas and feelings

Almost all of the participants emphasized that the students enjoyed the implementation of drama-based mathematics activities. In addition, six of the PSMTs expressed that students were curious about the classroom setting and were surprised with the new teaching method of playing games in their mathematics lessons. Only one preservice teacher mentioned that her students found the activities childish according to 8th Grade.

Time management

PSMTs had no implementation experience in real classrooms before. Almost half of the PSMTs (10 out of 21) had no problem with time management for their implementation of drama-based lesson plans. On the other hand, four PSMTs stated that drama-based instruction took more time, activities were time consuming and they needed extra time for implementation. However, two PSMTs finished their drama-based instruction earlier than expected. Five of them expressed that they could not balance time sharing between phases of drama-based instruction such as warm-up, development, and evaluation phases.

Difficulties related to physical environment

In the third category, PSMTs shared their difficulties related to the physical conditions and seating plan. Traditional classrooms have more space allocated for desks and so less free space for movement. As a result, the PSMTs expressed that they needed more free space in their classrooms, especially for warm-up activities during drama-based instruction. Physically organizing the classroom took time and effort (17 out of 21). Four of the PSMTS stated that they had time before the lesson and they did not encounter any problems related to the physical conditions.

Group work and cooperative learning

The group work and cooperative learning were revealed as the fourth category from analysis of the PSMTs' written responses. Most of the PSMTs (15 out of 21) stated that they experienced no problems about students' roles in group work or cooperative learning during drama-based activities. However, five of the PSMTs expressed that students were confused and required additional information about their group roles. Only one PSMT stated that students expected a competition during the drama-based instruction and they wanted to be the first runner-up or champion of the game. This is why the implementer explained cooperative learning principles several times to the students.

Difficulties related to the implementation process

In the fifth category, the difficulties PSMTs faced during the implementation of drama-based instruction in mathematics lessons were explained. Of the twenty-one PSMTs, ten emphasized that some of the students were unwilling to participate in the drama-based activities. Also, five stated that they had no experience in responding to student feedback, and this is why they encountered difficulties facilitating the planned activities. In addition, two of the PSMTs forgot some parts of their lesson plans and had to return to the forgotten phases later on. Two of the PSMTs had difficulties

related to the materials of their activities and another two had difficulty with classroom management during the warm-up phase while students were walking into the classroom.

Feelings and opinions of PSMTs

Feelings and opinions of the PSMTs were summarized in the sixth category. In spite of the PSMTs lack of experience in real classrooms, all of them enjoyed their implementation and believed that they would implement drama-based instruction in their future mathematics lessons. Some of the PSMTs opinions are shows as follows:

PSMT-9: "*I enjoyed my lesson and I am very happy for being a teacher." PSMT-1: "I saw my students were smiling during my lesson and it motivated me. I should practice my teaching profession because I love my brilliant and creative students*."

Most of the PSMTs emphasized in their written responses that they witnessed normally low-performing students happily attending mathematics lessons during the drama-based instruction. PSMT-16: "*A student who was not interested in previous mathematics lessons and gave their exam sheet early, participated in the activities voluntarily and became interested in the mathematics lesson"*; PSMT-2: "*Three students who were not interested in math lessons, participated in the drama-based activities voluntarily and their eyes were shining".*

However, most PSMTs thought that experiencing drama-based instruction during in-class training was different than the traditional method and that it motivated the students to learn mathematics. PSMT-7: "*My students shared their experience with their friends in other classes, who wanted to join the next week's classes*"; PSMT-21: "*Other mathematics teachers were curious about my successful implementation of drama-based instruction and communication with students*"; PSMT-9:"*Drama-based instruction can be useful in mathematics lessons for increasing students' motivation towards mathematics*".

Findings related to the strengths of drama-based instruction within mathematics lessons

The self-assessment reports PSMTs reflected on the strengths of drama-based instruction within mathematics lessons. The content analysis of written responses of PMSTs showed that all participants found drama-based mathematics instruction to be an effective teaching method. PSMT-5: "*If we use drama-based instruction for teaching mathematics, learning outcomes become permanent*"; PSMT- 12: "*Most of the mathematical concepts are abstract and drama helps concretizing abstract concepts*"; PSMT-2: "*Instead of learning mathematical concepts by rote, drama-based instruction stimulates meaningful learning*"; PSMT-9: "*During the drama-based activities students faced real life problems by means of dramatic moments and this fosters problem-solving ability*"; PSMT-13: "*In drama-based mathematics courses it is possible to construct real life connections of concepts*".

Some of the PSMTs paid attention to social skills development during the drama-based instruction process. PSMT-11: "Drama-based instruction supports social interaction between peers in mathematics classrooms"; PSMT-7: "*There are some students who don't attend routine classes, but drama-based activities encouraged all students to express their thoughts*"; PSMT-20: "*All the students in the mathematics classroom actively participated in the learning process. Also, students worked cooperatively during drama-based activities and their interaction progress*".

On the other hand, PSMTs emphasized the contributions of drama-based instruction on affective skills. PSMT-1: "*It makes the lessons entertaining and motivates the children*"; PSMT-8: "*It supports pupils in developing positive attitudes towards mathematics*"; PSMT-10: "*Children like attending drama activities, because they construct knowledge through their previous experiences*".

Findings related to weaknesses of drama-based instruction within mathematics teaching

On the self-assessment reports the PSMTs reflected on the weaknesses of drama-based instruction within mathematics lessons. The responses were analyzed by using content analysis. Some of the PSMTs found drama-based instruction to be time consuming. PSMT-20: "*We have to complete the mathematics curriculum, but drama-based lessons require much more time*". On the other hand, PSMTs also mentioned problems related to physical environment. PSMT-19: "*The physical environment of the classroom will limit in-class implementation of drama-based instruction. Students need to move and act during drama-based instruction and especially in crowded classes some difficulties may occur*"; PSMT-14: "*Technical equipment problems in the classroom will limit the in-class implementation of drama-based instruction*". Besides, most of the PSMTs expressed that classroom management during drama-based instruction requires expertness and teachers need to be well prepared for implementing drama-based activities. PSMT-7: "*Without taking any training on drama-based instruction, I think it would be impossible to develop lesson plans*". On the other hand, teachers need to be experienced in facilitating drama-based activities. Some of the PSMTs complained of the noisy classroom environment during drama-based activities, with those who practiced their lesson plans with 8th Grade students indicating many more difficulties. On the other hand, PSMTs who practiced their lesson plans with 5th and 6th Graders reflected less difficulties and expressed more positive thinking related to the implementation of drama-based instruction.

CONCLUSION

The aim of this study was to identify pre-service mathematics teachers' perceptions of drama-based instruction in terms of rudiments, development of lesson plans and assessment of implementation processes. Participants were senior class preservice mathematics teachers where their competency for implementing drama-based instruction was more of an issue. During undergraduate education, preservice mathematics teachers take the courses of "instructional principles and methods", "methods of teaching mathematics-I", and "methods of teaching mathematics-II". Within the contexts of these courses, preservice mathematics teachers learn to apply the methods of teaching elementary school mathematics, understand the processes of instructional planning, prepare and present plans for mathematics instruction which utilize different teaching methods, and design and implement plans and activities. Initial assessment results of the open-ended evaluation form revealed that senior class mathematics teacher candidates are not aware of the drama-based instruction as an instructional strategy for teaching mathematics. Most of the participants could not define drama-based instruction and its key components. On the other hand, they lacked knowledge related to the techniques and phases of drama-based instruction. During the final assessment, after the implementation of the drama-based instruction with preservice mathematics teachers over 11 weeks, the vast majority of participants were able to define drama-based instruction, and its phases and components. Findings associate with the implications defined by Heinig (1988) and Wright (1985).

Analysis of lesson plans developed by the preservice mathematics teachers showed that staging a drama-based mathematics course enriched their professional teaching knowledge. However, whilst at the initial assessment none of the participants were able to give examples of drama-based instruction, by the end of the semester all of the participants were able to develop unique lesson plans. Wright (1985) attached importance to the teacher training programs for extensive usage of drama-based instruction. During the research period of the current study, preservice

mathematics teachers attended drama sessions, and prepared and practiced drama-based lesson plans with pupils. Analysis of the lesson plans executed revealed that participants made great progress in developing drama-based mathematics lesson plans. Their plans were well-structured, including the phases and components of drama-based instruction, adequate in terms of dramatic moments, drama techniques and make-believe plays. A review of the related literature also promote these findings (Heinig, 1988; McCaslin, 1990; Neelands & Goode, 2015).

With respect to the findings related to the opinions of preservice mathematics teachers, all participants enjoyed the usage of drama-based instruction during mathematics lessons, although they met some difficulties during the implementation process. Most of the difficulties were related to the physical environment, as well as a lack of experience of the preservice mathematics teachers. According to Wright (1985), teacher candidates need extensive experience in order to implement drama-based lesson plans efficiently. Opinions of preservice mathematics teachers in the current study related to the strengths of drama-based instruction were similar to the findings of previous studies (Ballou, 2000; Duatepe, 2004; Erdoğan & Baran, 2009; Freeman, 2000; Saab, 1987; Üstündağ, 1997).

The current study revealed that usage of drama-based instruction in mathematics lessons depends on the preparedness of the mathematics teacher. When viewed from this aspect, mathematics teacher education programs can play a big role in offering drama-based courses to teacher candidates. Besides this, contents of the "methods of teaching mathematics-I" and "methods of teaching mathematics-II" courses can be extended by means of involving drama-based instruction. Preservice mathematics teachers can also be encouraged to use drama-based activities during their school practice.

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