

*Full Length Research Paper*

## Elective drama course in Mathematics education: An assessment of pre-service teachers

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**This study aimed to evaluate a newly introduced elective course “Drama in Mathematics Education” into mathematics education curriculum from the viewpoints of pre-service mathematics teachers. A case study was employed in the study. The study group consisted of 37 pre-service mathematics teachers who were enrolled in a Turkish state university’s faculty of education. The participants’ written opinions were gathered about the course and the use of drama in teaching mathematics and the data were subjected to content analysis. Findings indicated that pre-service teachers think that the course is useful as it has many personal, professional and social benefits for them and the drama can be used in almost all subjects of mathematics.**

**Key words:** Drama, Mathematics Education, Drama in Mathematics Education.

### INTRODUCTION

In Mathematics Education, like other subjects a variety of methods and techniques are used in order to make learners play an active role in their learning instead of being just listeners and playing a passive role. Some of these methods and techniques commonly used in mathematics education are plain lecturing, question-answer, teaching by discovery, discussion, teaching by analysis, teaching through modules, demonstration and practice, teaching by script, teaching by games, project-based teaching, collaborative teaching and problem-based teaching (Altun, 2012; Uğurel, 2003). On the other hand, game-based teaching methods are the umbrella term used for role playing, drama, pedagogic games, teaching by games and teaching by script (Kaplan et al., 2011). These methods and techniques overlap each

other in terms of creating real or fictional environments for the target information, skill or attitude and of using some role-plays and games in that environments.

Drama is one of the game-based methods and techniques and its application area is gaining wider acceptance. It can be defined as a “game-like” process in which individuals make sense of and dramatize an experience, an event, an idea, an educational unit or an abstract concept or a behaviour in a group setting with the techniques like improvisation and role playing. In a drama activity, the individuals review their expectations, emotions and experiences by reformulating their former cognitive patterns (San, 1994). Drama is a method that makes students be more active in class, makes it possible to create opportunities for students to express their

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mathematical thoughts in class. It helps them to understand mathematical concepts and overlap them, as suggested by the mathematics curricula (Akkus, 2006). In addition, this method is a good way for children to explore the concepts, acquire the knowledge and improve their thinking-skill (Johnson, 2002).

Many researchers have been interested in the use of drama in Mathematics Education and given certain suggestions about the educational benefits of the drama. For example, Carter and Westaway (2005), state that there should be a direct link between real life and Mathematics, and the students, who have certain negative attitudes towards Mathematics as a hard, boring and disliked subject (Duatepe and Çilesiz, 1999; Hatipoglu, 2006; Ornek, 2007; Ozsoy and Yuksel, 2007), can change their attitudes. Also, Crawford and Witte (1999), claim that Mathematics Education based on actively involved activities helps students to direct their energy to create solutions for the problems. These problems could be in real-life by providing arguments on solution strategies with their peers by using materials and by supplying them to develop their own terms by working in small groups. The studies show that drama positively contributes to students' attitudes, and especially, it ensures direct learning accompanied by doing entertainment (Erdogan, 2008), linking mathematics with the daily life (Carter and Westaway, 2005), concretizing abstract mathematical concepts (Erdogan, 2008), as well as indirectly improving social life skills and skills specified in mathematics curricula (Kara and Cam., 2007).

Not only does the drama has positive effects, but also it has improved skills in Mathematics Education and in social life. Particularly, the drama positively influences the skills which the mathematics teaching program aims to improve in students such as reasoning, communicating, relating and problem solving, as well as students' attitudes towards and abilities in mathematics and their academic achievements (Duatepe, 2004; Erdogan and Baran, 2009; Hatipoglu, 2006; Ornek, 2007; Sezer and Ozturk, 2011; Tas, 2008; Yegen, 2003). The use of the creative drama technique is influential especially in endowing students with the skills of working in groups, establishing and maintaining relationships with others and self-controlling (Kara and Cam, 2007). Since the drama is a group activity, it contributes to the improvement of establishing communication, critical thinking, and being aware of responsibilities within a group. All these results overlap each other in terms of students' attitudes towards group-works on specific subjects, their discussion, communication and observation (NCERT, 2006).

Drama has been already added in the teaching programs of schools at different education levels in many developed countries, it is included in these programs either as a teaching method for teaching certain subjects or as a stand-alone course for the personality

development of students. In spite of the emphasize in the curricula of Mathematics Teaching Program (MEB, 2013) which proposes that students should be actively involved in learning process and teachers should create real-life learning environments, there is not any guideline in the curricula for mathematics teachers and even sample drama activities in the course books for the teachers to apply in the classrooms. Although, the role of teachers and teacher qualifications in making drama effective is mostly stated in a number of studies (example, Aytas, 2013; Karadag et al., 2008; Kerekes and King, 2010; Okvuran, 2003), the drama course has been a neglected course and only accepted as an elective course in some Teacher Education Institutions in Turkey. Therefore, there is not enough information about how to use drama as a teaching method (Erdogan, 2011), and there are obstacles to use drama effectively in mathematics education.

Most of the research about the use of the drama in mathematics education (see Paksu and Ubuz, 2010; Sengün and Iskenderoğlu, 2010) are based on quantitative data and they generally analyze the effect of drama over students' academic achievement, attitude, creativity and communication skills. However, those studies are mainly based on kinder garden, primary school and secondary school education. Then there is a need for analyzing tertiary level based studies in the literature. Another point is the lack of research about teacher perspectives in the use of Drama as most of research were just conducted with students' participation. Although, there are some studies considering teachers' viewpoints (example, Erdogan, 2011; Tezer and Aktunc, 2010), those studies focused on the teachers' opinions over active learning strategies rather than the use of the drama (Salman, 2009). There are very few studies based on pre-service teachers. In one of these studies, Güneysu and Temiz (2012), evaluated just the use of role-play in pre-service education rather than the Drama activity which involves learners actively participation in the whole process by stating the subject, writing the scenario and making the role-play.

In sum, there is not enough information about how to use Drama as a teaching method, and Drama is not taught adequately at tertiary level. There is a need for gathering opinions of pre-service teachers on Drama, subjects on which Drama can be used, the pedagogical effects of the use of the Drama in Mathematics Education.

For this purpose, the course "Drama in Mathematics Education" was offered for the first time as an elective course in the department of Elementary Education Mathematics Teaching in the Faculty of Education at a Turkish university. Determining the opinions of pre-service teachers who selected the course named "Drama in Mathematics Education" was aimed in this study. The sub-problems of the study in line with the above purpose were as follows;

1. What are the opinions of the pre-service teachers who selected the course named "Drama in Mathematics Education" about the use of the drama method in mathematics education?
2. What are the opinions of the pre-service teachers who selected the course named "Drama in Mathematics Education" about teaching mathematical subjects in which the drama method should be used?
3. What are the opinions of the pre-service teachers who selected the course named "Drama in Mathematics Education" about the benefits of the drama method in mathematics education to themselves?
4. What are the opinions of the pre-service teachers who selected the course named "Drama in Mathematics Education" on the possible inclusion of the course in the curriculum of the Elementary Education Mathematics Teaching undergraduate program?

## METHODOLOGY

In this study, a case study from qualitative research models was adopted in order to deeply handle the problem. Mcmillan (2000), defines the case study as a method in which one or more events, media, programs, social groups or other interconnected systems in a thorough way, and suggests that its purpose is to come up with detailed descriptions about a situation. Then, the case study is a widely recognized inquiry method of investigating a phenomenon about real life context and it enables valuable insights on exploring new ideas about that situation (Merriam, 2007; Yin, 2003).

### Study group

The study group of the research comprised 37 third-grade pre-service Mathematics teachers who took the Drama course at a university located in the eastern part of Turkey. During the participant selection process, the students who took the course and accepted to voluntarily provide written opinions were considered as the criteria.

### Application

The "Drama in Mathematics Education" was a single term elective course. It was taught in two hours per week (26 hours in 13 weeks). In the first three weeks, the pre-service teachers were informed by the researcher on the subjects of teaching Mathematics methods and techniques, role-plays, educational games, drama techniques, the significance of Drama in Mathematics Education, components and dimensions of Drama. Then, sample plays-scenarios-scripts were read, screened and some basic exercises were held in the class with the participants. In the fourth week, the pre-service teachers were given a certain time and asked to form groups that would consist of at least two people. The sequence of the groups was determined by random selection. In that week, sample activities for review were distributed and one more week for deciding the content of their activities was given to the participants. During this process, the participants were free to review the literature provided by the researcher or to create their own activities by writing and constructing on their own as a group. In the week of the course, the activity of the each group was checked by the researcher for suitability for the objective, and necessary corrections were made.

At the end of that week, the groups, their turns and activity topics were finalized.

In each of the sixth, seventh, eighth, ninth, tenth and eleventh weeks; two groups presented their activities within a time period of 20 to 40 minutes. It was ensured that the activity topics would fit to the levels of elementary education fifth, sixth, seventh and eighth grades. Each group procured on their required materials for their activities such as scenery, costume and music. Some groups preferred to have activities which were consist of more than one short scenario. Each week, the researcher controlled the scripts of that week's presenters one final time, in order to reduce or eliminate the possibility of moving away from the purpose of the course. In the twelfth week of the course, the participants were invited to give their written opinions according to the pre-determined interview questions. A sample activity prepared by a group was shown below:

Name of the Play: Make Your Choice

Learning Domain: Permutation and Combination

Objective: Seeing where one encounters the subjects of permutation and combination in the daily life.

Players: Fatma, Yasemin, Aysegul, Father, Mother, Sister 1, Sister 2

Location: Outside the training centre, home

Time: Sunday afternoon

Scenario:

*(Three friends who just left the training centre on a Sunday would like to do something but cannot decide where to go.)*

FATMA: Come on friends; let's go somewhere today.

YASEMIN: Yes, we are very tired of studying. The school on weekdays and the training centre on the weekend; we should spare some time for ourselves.

AYSEGUL: You go, guys; I want to go home and rest.

FATMA: Come on Aysegul, we know you will go home and study.

AYSEGUL: Well, OK. I am coming, too.

YASEMIN: OK, where should we go?

FATMA: Firstly let's eat something, aren't you hungry? After then, we can arrange something.

AYSEGUL: I agree girls! Let's eat first. I remember that there is a nice play today; we can go to the theatre.

YASEMIN: No, I have already seen it. I think we should do something else.

FATMA: Then, we can go to cinema to watch a new movie of Brad Pitt. Girls, its trailer was awesome and the actor was very handsome.

YASEMIN: No. Girls, the winter season has just begun, I think we should go shopping.

*(These three friends agree to eat first; however they also need to decide where to go after eating. If, among the four alternatives, eating is certain, then how many different choices can they make out of the remaining three?)*

*(They decide to go to the movies [Fatma's suggestion] ruling out play [Aysegul] and shopping [Yasemin].)*

*(They buy three tickets for three side-by-side seats. Now, they cannot decide who should sit on which seat.)*

FATMA: I want to sit in the middle.

YASEMIN: I want to sit beside Aysegul.

AYSEGUL: Girls, I never sit on the sides, just so you know.

*(They try each option one by one, and finally sit in the following order: Fatma, Aysegul and Yasemin.)*

*(The movie ends and everyone heads home. It is time for dinner when Fatma arrives at home.)*

*(Fatma has a family of six.)*

FATHER: Come on my daughter, we are waiting for you.

FATMA: I am coming after washing my hands, Dad.

*(Fatma comes to the table.)*

FATMA: Mom, I want to sit beside you this time.  
 MOTHER: Oh, but your sister is only two years old, she needs me while eating.  
 FATMA: Ah, yes Mom, I could not think of it. You know, we learned a subject in the training centre today through which we can easily make this arrangement. I guess its name was circular permutation.  
 SISTER1: Dad, I want to sit on your place.  
 FATHER: No way! This has been my place for years.  
 SISTER1: Oh Dad, is there such a rule?  
 FATHER: Oh you young people!  
 SISTER1: OK Dad!  
 FATMA: OK, so let me help you. Now; me, my sister and mom sit in this order. Sister, dad and sister line up this way. I guess this is what everybody wanted.  
 MOTHER: Oh good girl, how easy you managed this. See, you have been complaining about the use of mathematics in the real life.  
*(Dinner ends.)*  
 MOTHER: Now, you should help me out.  
 FATMA: But I got very tired today.  
 MOTHER: What did you do today?  
 FATMA: We wanted to do something with the girls after the training centre. Yasemin wanted to go shopping, Aysegul offered to watch a play, and I suggested to see the film which I had been wondering about. But first, we need to eat. After eating, we made the decision on where to go, and we decided to go to the movies. There again, we struggled to decide who should sit where. Bu then; we sat in this order: I, Aysegul and Yasemin.  
 MOTHER: Well, it seems you had a nice day. But you will still help me out!  
 SISTER1: If Fatma does not help, I don't either!  
 MOTHER: One of you will help me clear the table, another wash the dishes and the other put up the dishes.  
 FATMA: I am clearing the table!  
 SISTER1: I don't want to wash the dishes. So, I will put them up.  
 SISTER2: Oh, I am washing the dishes again!  
*(One of the sisters figures out that the subject of selective combination that she has learnt at school should be used here and tells it to the family.)*  
*(Everything is done and everybody goes into their rooms.)*  
*(They spend a month like this: The mother only takes care of her children, the father complains about it. They start a serious discussion. The mother leaves the house. The father, who can stand this situation only for a couple of months, participated in a "marriage broker show" on TV and invites the mother. She has two choices: Reunite or not. She has to choose one of them. She decides to reunite. Thus, she picks one of the two choices.)*

#### Data collection instrument

The data in this study was collected through a written interview protocol including structured questions. The protocol included four research questions which were determined with two experts from mathematics education area. These questions were as follows:

1. Do you think using the Drama method in Mathematics Education is useful? Please explain in detail with your reasons.
2. What subjects do you think using the Drama method in Mathematics Education is useful on? Please explain in detail with your reasons.
3. Please explain the skills (personal, professional and social) which you think using the Drama method in Mathematics Education is useful in improving.
4. Do you think the course "Drama in Mathematics Education" should be included in the Mathematics Teaching Undergraduate

Program as a compulsory or an elective course? If yes, what should be its weekly course hours? Please explain in detail with your reasons.

#### Data analysis and presentation

37 participants' written opinions were transferred to the computer environment. Then, those texts were subjected to content analysis to obtain the concepts and relations which explain the collected data (Yıldırım and Şimşek, 2008). During the data analysis process, third experts worked together. Two experts created their own codes and categories for each question. With face to face discussions, the experts talked about the differences about their ratings, and generally reached a 95% consensus. In some cases, a third expert accompanied the discussions and helped the finalization of the codes and categories. During the presentation of study findings, frequencies related to each code and category were presented in tables according to the questions. In addition, some sample excerpts were given to support the findings in tables. The students' excerpts were coded as X1, X2, X3, and so forth according to the interview sequence.

#### FINDINGS

In this section, the study findings were presented in tables and sample excerpts of the participants were given according to the findings.

#### Findings on the first research question

Table 1, showed the findings obtained through the analysis of the first question "Do you think using the Drama method in Mathematics Education is useful? Please explain in detail with your reasons." This question answered to the first research question: *What are the opinions of the pre-service teachers who selected the course named "Drama in Mathematics Education" about the use of the drama method in mathematics education?* Findings were presented in Table 1.

As Table 1 showed, responses of the two pre-service teachers (X21 and X34) were left out of assessment as they were not relevant to the question. The remaining 35 students had positive opinions on the use of drama in mathematics education. The following order of frequency of the codes was obtained after analysing the responses that the participants gave to the question "Why?": Entertaining, lasting, endearing, informative, concretizing, attention-grabbing, visual, comprehensible, daily life, discovering skills, cooperative learning and different point of view. The code "entertaining" in this table emerged as a result of the analysis of the responses given by the participants who thought that Drama made Mathematics entertaining. An example is the following stated by X28:

*"... Mathematics is perceived by students as frightening. Therefore, drama will make this course more entertaining and informative".*

**Table1.** Findings on the first sub-problem of the research.

Codes	Student names that form the codes	Frequency
Entertaining	X5, X7, X9, X10, X11, X12, X18, X20, X22, X23, X24, X25, X26, X27, X28, X29, X30, X31, X35	19
Lasting	X3, X5, X10, X13, X14, X15, X20, X23, X25, X27, X32	11
Endearing	X8, X19, X23, X29, X30, X36, X37	7
Informative	X9, X10, X24, X26, X28, X31, X36	7
Concretizing	X2, X5, X6, X18, X22, X31	6
Attention-grabbing	X4, X15, X32, X32	4
Visual	X3, X13, X15, X20	4
Comprehensible	X12, X14, X17, X23	4
Daily life	X1, X12, X26, X37	4
Discovering skills	X16, X22	2
Cooperative learning	X16, X33	2
Different point of view	X2	1

The code “lasting” in the Table 1 emerged as a result of the analysis of the responses given by the participants who stated that drama was effective in rendering permanent what was learned in the mathematics course. An example of this issue was stated by X23:

*“...Activities performed in the course of drama both render the class entertaining and provides an educational environment in which learning is more permanent”.*

The codes “endearing” and “informative” in the Table 1 emerged as a result of the analysis of the responses given by the participants who stated that drama has a role to endear mathematics and to make it easier to teach. Examples to these two codes are the following stated by X9:

*“...It enables us to easily and entertainingly learn a course that is hard and serious as mathematics”* and stated by X8: *“...It is a very useful method to endear Mathematics to students”.*

The code “concretizing” was formed by the participants who expressed that the mathematics course that involves abstract concepts is concretized through drama. Two examples are the following stated by X18:

*“...Mathematical subjects are concretized in the mind thanks to the drama method”* and by X22: *“...through Drama, abstract and boring subjects become concrete and entertaining”.*

The code “attention-grabbing” was formed by the participants who expressed that attentions of students in the mathematics course can be attracted through drama. The code “visual” emerged as a result of the analysis of

the opinions of the participants who stated that drama adds a sensory organ to the process of learning by appealing to the eyesight. An example is the following stated by X2:

*“...Learning by seeing will be more effective in students”.*

The code “comprehensible” was formed by the participants who think that comprehending Mathematics becomes easier through Drama, whereas the code “daily life” was formed by the participants who stated that Drama makes students aware of the uses of Mathematics in their daily life. An example to the latter code is the following stated by X1

*“...Being able to see the functions of mathematics in the daily life”.*

The code “discovering skills” was formed by the participants who argued that individuals who possess certain skills that they are not aware of it can discover these skills through drama. The code “cooperative learning” was formed by the participants who think that students find in Drama the opportunity to work and share with their peers leads to widening their social lives. Finally, the code “different point of view” was formed by the following expression stated by X2:

*“...I think that students become capable of thinking better and their perspectives are widened when mathematics is taught through drama”.*

### Findings on the second research question

Table 2, showed the findings obtained through the Eight

**Table 2.** Findings on the second research question.

Subject(s)	Students names that form the codes	Reason(s)
All subjects	X9, X10, X11, X23, X24, X26, X31, X34	Efficiency (X9, X10, X31), Elementary subjects are superficial (X11), Concretizing (X26), -(X24, X34)
Every subject that is difficult to comprehend	X17, X28, X29, X30, X33, X35	Giving meaning (X17), Concretizing (X28, X29), Instructiveness (X28), Making course pleasurable (X30), Facilitating comprehension (X30), - (X33), Associability with the daily life (X35)
Abstract subjects	X2, X4, X12, X15, X21, X28	Concretizing (X2, X4, X12, X15, X28), Making easier (X21), Instructiveness (X28)
Subjects that are encountered in the daily life	X20, X37	Improving creativity (X20), Facilitating learning (X37)
Numbers	X36	Concretizing (X36)
Whole numbers	X5, X25	Suitable for games (X5), Concretizing (X25)
Fractions	X8, X18, X25, X27	Associability with the daily life (X8, X27), Concretizing (X25), Suitable for material use (X18)
Sets	X5	Suitable for games (X5)
Patterns and Tessellations	X5	Suitable for games (X5)
Algebraic expressions	X22	Suitable for visualization (X22)
Problems	X13, X16	-(X16), Associability with the daily life (X35)
Functions	X25	Concretizing (X25)
Permutation-Combination-Probability	X1, X6, X13, X27	Facilitating comprehension (X6), Associability with the daily life (X13, X27)
Geometry	X8, X19, X22, X32, X36	Associability with the daily life (X8), Suitable for visualization (X22, X32), -(X19), Concretizing (X36)
Geometrical objects	X1	-(X1)
Geometrical concepts	X14	Suitable for games (X14)
Area-volume calculations	X5, X18	Suitable for games (X5), Suitable for material use (X18)
Triangles	X5	Suitable for games (X5)

analysis of the second question “*What subjects do you think using the Drama method in Mathematics Education is useful on? Please explain in detail with your reasons.*” The question sought answers to the second research question: *What are the opinions of the pre-service teachers who selected the course named “Drama in Mathematics Education” about teaching mathematical subjects in which the Drama method should be used?*

Findings were presented in Table 2, participants stated that the Drama method can be used in all mathematical subjects as they think that the drama allows them to create activities, it helps them to concretize learning subject and elementary school subjects are easy subjects to teach. On the other hand, six participants stated that Drama can be used in every subject difficult to comprehend as it gives meaning to and

concretizes concepts, as it is instructive and renders the class pleasurable, as it makes comprehension easier and it links subjects with the daily life. Three participants think that drama can be used while teaching abstract concepts for its features of concretizing, facilitating and instructiveness. On the other hand, two participants stated that drama should be used for teaching subjects that are relevant to the daily life as it

**Table 3.** Findings on the third research question.

Dimensions	Codes	Students names that form the codes
Personal	*Self-confidence/Confidence	X4, X5, X7, X11, X12, X13, X15, X18, X20, X22, X23, X24, X25, X27, X28, X31, X33, X34, X36
	*Skill of writing and executing a play	X6, X14
	*Creative thinking	X20, X22, X37
	*Acquiring different points of view	X20, X35
	*Skill of role-playing and imitating	X16, X30
	*Reasoning/Problem-solving	X21
	*Imagination and creativity	X9
Professional	*Different teaching methods and techniques	X10, X11, X13, X15, X22, X23, X27, X28, X32
	*More effective teaching	X2, X3, X8, X12, X19
	*Self-confidence of the educator	X20
	*Understanding students and lowering the self to their levels	X2
	*Skill of endearing the course	X37
	*Classroom management	X12
Social	*Areas of use of mathematics in the daily life	X26
	*Ability to express oneself in front of people	X1, X4, X5, X7, X9, X11, X12, X18, X21, X26, X29, X33, X34
	*Socialization	X7, X5, X8, X12, X15, X21, X25, X36
	*Establishing communication	X14, X19, X36
	*Working in groups and cooperation	X25, X26, X37
	*Respecting others' opinions	X26

enables students to be more creative and it facilitates learning. Participants who responded outside these codes specified certain learning domains while reasoning their responses. The learning domain of geometry is the one with the highest frequency (5 participants) as it is linked with the daily life, and it allows for visualization and concretization. The code concretizing, on the other hand, is the reason expressed by the participants with the highest frequency (15 participants).

### Findings on the third research question

Table 3, demonstrated the findings obtained through the analysis of the third question *"Please explain the skills (personal, professional and social) which you think using the Drama method in Mathematics Education is useful in improving."* The question sought answers to the following third research question: *What are the opinions of the pre-service teachers who selected the course named "Drama in Mathematics Education" about the benefits of the Drama method in Mathematics Education to themselves?* Findings were presented in Table 3.

Table 3, showed that students mentioned three different types of development: personal, professional and social. The item of development which the participants

emphasized most under the heading "personal" is the code self-confidence/confidence. Participants in this code stated that they acquired self-confidence or their self-confidence increased. An example is the following stated by X20:

*"...First of all, I gained self-confidence; I realized that I could do whatever I want, because we performed in front of the entire class".*

The number of participants who stated their creative thinking skills had improved is three. Each of the codes "skill of writing and executing a play", "acquiring different points of view", and "skill of role-playing and imitating" were expressed by two participants. On the other hand, the codes "reasoning/problem-solving" and "imagination and creativity" had one respondent each. Nine of the participants who pointed to a professional development formed the code "different teaching methods and techniques". This code means that Drama helped them to learn a new Mathematics teaching method or technique. An example is the following stated by X27:

*"...I have learned a very unique and good method that will enable me to simplify mathematics while teaching it to children".*

**Table 4.** Findings on the fourth research question.

Codes that emerged as a result of the question "Should it be included?"	Codes that emerged as a result of the question "What should be its weekly course hours?"	Student names that formed the codes
Yes, it should be included	3-4, 2, -, 4, 2	X1, X5, X21, X22, X33
Compulsory	3, 2, -, -, 3, 4, 3-4, 4, -,3, 3, 4, 2, 2, 2	X3, X6, X8, X9, X17, X19, X23, X24, X26, X27, X28, X30, X32, X35, X37
Elective	-, -, 4, 4, 2, 4, 2, 2, -, 2, -, 2, -, 2	X2, X7, X8, X10, X11, X12, X13, X14, X15, X20, X25, X29, X31, X34, X36

Five participants, on the other hand, who stated that they had learned how to provide a better and higher quality of education, formed the code "more effective teaching". The following response of X20 formed the code "self-confidence of the educator":

*"I feel like a real educator, because I made efforts for an effective teaching".* Similarly, while the following statement of X37 formed the code "endearing the course": *"...It showed us the ways to endear the course to our students";* the following statement of X26 formed the code "areas of use of mathematics in the daily life": *"...It showed me that mathematics is not only theoretical but it is also used in the daily life".* The code "classroom management" was formed by X12's statement *"...It improved my ability to control the class"*, whereas the code "understanding students and lowering the self to their levels" was formed by X2's response *"...It enabled us to understand students and lower ourselves to their levels"*. Under the category of "social", 13 participants formed the code "ability to express oneself in front of people". An example is the following stated by X29: *"... Now, I feel more comfortable with my circle of friends and I can express my opinions more freely and comfortably"*. The code "socialization" was formed by the responses of nine participants. An example is the following stated by X15: *"... I socialized more with people around me"*. Other codes emerged under this category are "establishing communication", "working in groups and cooperation" and "respecting others' opinions". X26's following response serves as an example for these three codes: *"...It taught me how to share works with my friends, how to respect others' opinions, how to fulfil my task, and how to be comfortable in front of other people"*.

### Findings on the fourth research question

Table 4 demonstrated the findings obtained through the analysis of the fourth question *"Do you think the course "Drama in Mathematics Education" should be included in the Mathematics Teaching Undergraduate Program as a compulsory or an elective course? If yes, what should be its weekly course hours? Please explain in detail with*

*your reasons."* The question answered the fourth research question: *What are the opinions of the pre-service teachers who selected the course named "Drama in Mathematics Education" on the possible inclusion of the course in the curriculum of the Elementary Education Mathematics Teaching undergraduate program?* Findings were presented in Table 4.

As Table 4, demonstrated the following three codes emerged as a result of the analysis of the fourth question: "Yes, it should be included", "Compulsory" and "Elective". The first group was formed by the participants who did not specify whether it should be compulsory or elective. The code "compulsory" was formed by the responses of fifteen participants who think that the drama course should be a compulsory course. While five participants stated that the course should be taught in three weekly hours, four suggested that the number of hours should be four, and four people said it should be two. On the other hand, two participants had no opinion on this issue. The code "elective" was formed by the responses of fifteen participants who think that the drama course should be an elective course. Five of these fifteen participants stated that the number of weekly hours should remain at two, whereas three of them suggested that it should be four. Five participants did not present any opinion on this.

The code that emerged as a result of the responses of the participants who formed the code "elective" is "volunteerism", because these responses suggest that the drama course can achieve its objective only if it is carried out on a voluntary basis. An example is the following stated by X10:

*"...I think this course should remain as an elective course, because it requires willingness and curiosity. It would not be entertaining when people are not willing to take it"*.

Responses of the participants who formed the code "compulsory" suggest that this is a course that must be taken by every pre-service teacher. Two examples are the following stated by X35:

*"...It should be compulsory, because every pre-service teacher should see that they can teach Mathematics by*



*using different ways and by rendering it more pleasurable*; and stated by X24: *"...I think it should be a compulsory course, because now Mathematics Education is mostly given through activities and links to the daily life. The drama course will endow pre-service teachers with relevant skills and knowledge"*.

## RESULT AND DISCUSSION

Drama is one of the modern teaching methods/techniques used in Mathematics Education. In this study, aiming at determining pre-service Mathematics teachers' thoughts on the use of Drama course in Mathematics Education showed that students are in favour of use of the Drama in Mathematics. The participants specified the following reasons and codes by indicating that Drama is an entertaining, lasting, endearing, informative, concretizing, attention-grabbing, visual, comprehensible activity and it is related to daily life, which helps them discover their skills, enhances cooperative learning in the class and gives different insights about the life.

The following codes emerged in the study carried out by Uğurel (2003), with pre-service teachers on the advantages that drama activities would provide in teaching: increasing interest, enhancing motivation, learning by entertainment, ensuring long-lasting and fast learning, improving attention and increasing communication. These codes are largely similar to the codes obtained in the current study. Moreover, similar findings were obtained in the study carried out by Erdogan (2011) in order to evaluate the opinions of teachers and instructors who use creative drama as a method in mathematics education. According to Erdogan (2011), creative drama is an effective method which can be used in Mathematics Education, as it mentally and physically incorporates learners into the learning process. However, the idea of Annarella (2000) which is "drama is one of the most effective methods to teach the goals of the teaching program" also supports the findings of the current study. In addition to these studies, Tezel and Aktunç (2010) supporting the idea of use of Drama in Mathematics found that while teacher extensively used the Drama in their teaching at the beginning, they digressively used Drama in the following years.

The result of the second research question showed that 22 of the participants think that Drama can be used in teaching Mathematical subjects (all subjects [8], subjects which are difficult to comprehend [6], abstract subjects [6], and subjects encountered in daily life [2]). In addition, 15 participants stated that drama can be used in the following learning domains: numbers (numbers, whole numbers, fractions, sets), algebra (patterns and tessellations, algebraic expressions, problems, functions), statistics and probability (permutation, combination and probability), geometry (geometrical objects, geometrical

concepts, triangles), and calculations (area and volume calculations). The sub-domain "fractions" under the domain "numbers" (4 participants) and the domain "geometry" (5 participants) constitutes the areas where drama can be used in mathematics education.

The names of learning domains and sub-domains which emerged in the codes expressed by the participants were used in a number of studies in the literature. Some of them are as follow. In the study conducted by Soner (2005) with elementary education third-grade students, a statistically significant difference in the favour of the experimental group was found between the mean achievement score of the group, in which the subject of Adding-Subtracting in Fractional Numbers was taught using the drama method and the achievement score of the group, in which the same subject was taught in the traditional way. It was observed in another study that the subject of trigonometry taught using enacting activities had a significant positive influence on the Mathematical achievements of elementary school eighth-grade students, on the level of subject's permanence in mind, and on students' attitudes towards mathematics (Ornek, 2007).

The study carried out by Duatepe and Akkus (2006), was aimed at exemplifying the use of Creative Drama as a method in Mathematics Education. The findings of the study indicated that drama played a significant role in teaching mathematical concepts in the favour of the control group. In another study (Hatipoglu, 2006), the influence of the Drama method on students' achievement levels in elementary school fifth-grade Mathematics course subjects was examined by being compared the achievement levels of control and experimental groups through the assessment instruments prepared for 10 acquisitions selected from the Units "Numbers in Life" and "Geometric Figures". The study found significant differences in the favour of the experimental group in 8 of 10 Mathematical Achievement Tests used for 10 acquisitions. Ozsoy (2003), used the creative drama method while teaching the elementary education eighth-grade subject of "Properties and Volumes of Right Prisms", and observed that it positively influenced student success. In the study carried out by Ekinozu (2003), with the aim of determining the influence of teaching the elementary education subjects of permutation and probability through dramatization upon academic achievements, it was determined that the Drama method and the plain lecturing method equally affect students' achievements, whereas the permanence of the learning of students in the group in which the Drama method was used as well as their attitudes towards mathematics were found to be significantly higher than those of the group in which the traditional teaching method was employed.

As seen in the examples given from the relevant literature, the drama method yielded positive results with respect to certain variables. In this respect, the fact that

the participants in the current study listed subject names related to each learning domain and even that they think it is applicable to all subjects is in harmony with existing studies. In this context, it is highlighted that the participants were familiar with the names of subjects related to the learning domains in mathematics as they were taught these subjects and domains in the content of the course named "Special Teaching Methods" in the curricula. However, one of the reasons lying beneath the emergence of this result might have been the fact that the activities performed in the drama course had been implemented for almost all learning domains. On the other hand, in a research conducted with teachers and university professors (Erdogan, 2011), it is emphasized that the use of drama in all learning domains of Mathematics can create problems in applications.

The results of the third research question indicated that the participants think that the use of Drama in Mathematics Education improved their certain personal (27 participants), professional (18 participants) and social (20 participants) characteristics. The category of "personal" here refers to cognitive (creative thinking, reasoning, problem-solving, imagination and creativity and writing a play), affective (self-confidence/confidence, acquiring different points of view), and psychomotor (role-playing and imitation, performing a play) domains. On this issue, Adıguzel (2006), says that the most important advantage of Creative Drama as a learning method is drama's being integrated with cognitive, affective, social and kinaesthetic skills, and Dupont (1992), states that one of the purpose of Creative Drama in Education is to affect and stimulate all of the cognitive, affective and psychomotor behaviours of individuals. The codes that emerged under the category of "professional" are as follow: different teaching methods and techniques, more effective teaching, self-confidence of the educator, understanding students and lowering the self to their levels, skill of endearing the course, classroom management and areas of use of Mathematics in the daily life. On the other hand, the followings are the codes that emerged under the category of "social": ability to express oneself in front of people, socialization, establishing communication, working in groups and cooperation, and respecting others' opinions. The most serious improvement occurred in the code "self-confidence/ confidence" (19 participants). Other notable codes are as follow: "ability to express oneself in front of people" which was formed by 13 participants, and "different teaching methods and techniques" which were formed by 9 participants.

Responses given by the participants for the third research question are in line with the relevant literature. Yenilmez and Uygan (2010), determined that the impact of Creative Drama on the self-efficacy beliefs of seventh-grade students towards geometry was significantly positive. Tas (2008), in the study carried out with classroom

teachers, observed that the teachers strongly agreed that the use of Drama in the Mathematics course contributes to students' skills of problem solving and reasoning. Ozsoy and Yüksel (2007), maintain that Creative Drama socializes students and improves their listening and self-expression skills, and most importantly, it enhances creativity. In the study carried out by Kara and Cam (2007), aiming to determine the effect of Creative Drama on the acquisition of the social skills of working in groups, initiating and maintaining a relationship, and self-control in the course, it was observed that the Creative Drama method is influential on all constructs above. Debreli (2011), investigated the influence of drama-based teaching on the achievement levels of seventh-grade students in the subject of "Ratio and Proportion" as well as on their attitudes towards Mathematics.

## CONCLUSION

In this study, the finding that the experimental group students performed better than control group students led to the conclusion that education based on of Creative Drama allows for active participation, working in co-operation and self-awareness. In addition, McCaslin (2006, p.22) defines Creative Drama as a way of learning and self-expression, a technique of therapy, a social activity, and a form of art. In the study of Guneysu and Temiz (2012) which is about pre-service teacher's perceptions on vocabularies and metaphors about before and after drama course showed that "self-esteem and a teaching technique" are most frequently expressed concepts by the students after taking drama course.

The findings of the fourth research question showed that almost all participants (35 of 37 participants) think that the Drama course should be a part of Mathematics Education either as a compulsory or elective course. According to Okvuran (1993), inclusion of Drama courses in all levels of education might establish the contemporary education system and contribute to the process of training teachers and students who feel the need and excitement for self-improvement. Pre-service teachers' knowledge of the Drama method will advance if these learners follow relevant resources and practice drama more frequently. Therefore, pre-service teachers at all levels of Faculties of Education should be given the opportunity to benefit from Drama courses offered both inside and outside these faculties. Then, advances related to these courses should be conducted in the faculties. Particularly, Pre-Service Mathematics teachers should be provided with the required opportunities to experience and learn the contributions that Drama activities are to make to Mathematics courses.

## Conflict of Interests

The author have not declared any conflict of interests.

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