Alternative Method in Teaching Statistics: Creative Drama

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Creative drama is an active, interactive and reflective means of playing and practicing life (Adıgüzel, 2006) based on working in a shared role (Baldwin, 2009). Creative drama is used to teach subjects other than the drama's own subjects by employing the techniques it has. These subjects can be from any school subject or discipline whose objectives can be addressed with creative drama. In this method, it is possible to teach a subject to be covered in a dramatic study by allowing students to experience it personally by means of enacting (Adıgüzel, 2018). Creative drama is enacting with a group by using techniques such as improvisation, role playing and by making use of the experiences of the group (Adıgüzel, 2006).

Teachers and students actively recreate, change and adapt their perceptions of the world and people as they work in role through drama (McNaughton, 2004). It allows the participant to look at other people's lives in another time and place, or to examine one's own experiences as a result of an event (Adıgüzel, 2006). Creative drama focuses on the learning process rather than learning outcomes (San, 1998). It is a student-centred process in which experiential learning developed within a curriculum in the classroom environment can be promoted. Creative drama fosters the development of the skills of versatile thinking, creativity, oral and written communication (Annarella, 1992). With creative drama, it can be contributed to the training of students who can research, question, and internalize the desire for curiosity and discovery (Adıgüzel, 2018). It is one of the effective and innovative methods used in the construction of student-centred and constructivist mathematics teaching in mathematics education. The contribution of the creative drama method is important in the process of training students who adopt process-oriented thinking, solve problems, think and share what they think (Özsoy, 2010). When drama is used as a method, the possibility of the learner to make the information meaningful and useful increases (Bowell & Heap, 2019). Adıgüzel (2018) argues that as a method, creative drama is used to teach subjects other than the drama's own subjects by employing the techniques it has. The teacher uses drama techniques in order to achieve pre-determined objectives such as conveying information, arousing interest, solving problems and changing attitudes (McCaslin, 2016). In the lessons where creative drama is used as a method, it should be written in a plan. In drama activities, Answers to questions such as what, why, when, how, where, who, to whom (with whom)

constitute the whole configuration of the creative drama process (Adıgüzel, 2006). The lesson plan has to follow the stages of a) preparation-warm-up activities, b) role play/ improvisations and c) evaluation (Adıgüzel, 2006). Preparation-warm-up activities enable the participants to focus their attention. Activities directed to the establishment of trust and harmony can be implemented to create group dynamics. Interactive games are used effectively at this stage. The enacting stage includes activities through which a subject is formed, determined, shaped and exhibited to other participants (Adıgüzel, 2018). In the evaluation stage, evaluations are made as to whether the pre-determined objective has been achieved.

In the teaching process in which creative drama is used as a method, it is possible to teach a subject in a dramatic conflict, that is, in a dramatic structure, by using the techniques of creative drama through enacting and by making students experience the events (Adıgüzel, 2018; Metinnam, 2019). Although drama is used to teach a subject, the art form of drama must be used (Bowell & Heap, 2019). The leader should be able to discover the tension, conflict or the point of greatest interest and guide the class through an original work (McCaslin, 1996). The aim here is not only to enable the student to enact, but also to enable the student to ask questions and question the learning context (O'Toole & O'Mara, 2007). The leader should enable students to see the deep meaning underlying the subject addressed with drama and gain a deeper understanding (McCaslin, 1996; Metinnam, 2019). In the creative drama process, it is very important that the activities are interconnected, support each other and the role of the activities in achieving the objective should be determined (Adıgüzel, 2006). Components based on dramatic fiction such as role, tension, character, place, symbol, focus, language need to be addressed in the process (Adıgüzel, 2018). A leader who wants to use creative drama as a method should have both the subject area knowledge and the content knowledge of creative drama (Metinnam, 2019).

Living in a constantly developing and changing world may require encountering statistics in many areas of daily life. Statistics is no longer a field that we come across only in textbooks and academic studies. It has become a part of our daily life. Statistical content is encountered on television, in the news, on the Internet, in newspapers, advertisements, billboards and many other places. Especially, the process of struggling with a major pandemic has made it possible to understand how data and statistics come to the fore in daily life. Statistics is needed to make sense of the data encountered and to make inferences. Statistics is defined as a science in which data is collected for relevant questions, the collected data is organized and summarized, and these summarized data are analyzed and conclusions are drawn (Bluman, 2012). Statistics has an important place in international and national curricula. Within the scope of data analysis and probability, which is considered as one of the National Council of Teachers of Mathematics (2000)

standards, it is aimed to enable students to formulate questions, collect data to answer questions, organize data, describe data, use appropriate statistical methods in data analysis, and make predictions and inferences based on data. In the Ministry of National Education Curriculum (Ministry of National Education [MoNE], 2018), it is aimed to enable students to create researchable questions, collect data for research questions, analyse the collected data and interpret the results within the scope of data processing learning area in the mathematics curriculum. The data analysis process is the critical stage for the accomplishment of these objectives. One of the methods used in the data analysis process is measures of central tendency (Van de Walle et al., 2013). Measures of central tendency refer to a method that provides visual images such as graphical representations about data and consist of the concept of mean called arithmetic mean, median, and mode (Van de Walle et al., 2013). The arithmetic mean is defined as the number at which the values in the data group are equalized or as the equilibrium point of the elements (Van de Walle et al., 2013). The arithmetic mean can be found operationally by summing the data in the data group and dividing it by the number of data (Bluman, 2012; Keskin-Oğan & Öztürk, 2019; Van de Walle et al., 2013). The median is the value in the middle of the sequenced data set (Bluman, 2012; Van de Walle et al., 2013; Keskin-Oğan & Öztürk, 2019). The mode is the most commonly encountered value in the data set (Bluman, 2012; Keskin-Oğan & Öztürk, 2019; Van de Walle et al., 2013).

Measures of central tendency have been researched both operationally and conceptually from past to present in the literature. In their study conducted on undergraduate students, Pollatsek, Lima and Well (1981) observed that while some of the students could easily calculate the arithmetic mean of a data set, a surprisingly large proportion of the participants did not understand the concept of arithmetic mean and that among many undergraduate students, the perception that arithmetic mean is about calculation rather than a conceptual structure and that the arithmetic mean starts and ends with a simple formula is quite common. In the study conducted by Leavy and O'Loughlin (2006) with the participation of pre-service elementary school teachers, it was observed that one-fourth of the pre-service teachers learned the concept of arithmetic mean conceptually and used it correctly, one-third of the pre-service teachers could use it limitedly, and that the pre-service teachers confused the arithmetic mean with the mode in graphical representations. Similarly, Groth and Bergner (2006) in their study with pre-service elementary teachers concluded that the majority of the pre-service teachers calculated and interpreted the concepts of arithmetic mean, median and mode, but that they were quite inadequate in choosing the appropriate one out of these three measures. In the study conducted by Koparan (2015) with 10 middle school mathematics teachers to reveal the opinions of the teachers about the difficulties in learning and teaching secondary school statistics, it was concluded that the teachers think that it is positive that secondary school statistics subjects are taught gradually through each grade level and that their

students can make calculations about measures of central tendency, but they do not know how to apply and interpret these measures. Strauss and Bichler (1988) tested whether children realize whether the arithmetic mean is between the extreme values in the data group, evaluate whether the arithmetic mean can be equal to one of the values in the data group, and whether they take the zero in the data group into account when calculating the arithmetic mean of the data group. They concluded that the children were not aware that the zero in the data group affected the arithmetic mean of the data group, they were aware that the arithmetic mean would be between the extreme values in the data group, and they were aware that the arithmetic mean did not have to be equal to one of the values in the data group.

Cai (2000) conducted it to examine how sixth grade students perceive and represent the arithmetic mean algorithm from an international perspective. It was concluded that the students used algorithm and guessing and checking strategies while solving arithmetic mean problems, they mostly used algebraic representations when solving problems, and they had problems in applying the arithmetic mean algorithm in reverse. It was emphasized that this situation was not due to the students' lack of procedural knowledge about the arithmetic mean algorithm, but to the lack of conceptual perception of the arithmetic mean. Zawojewski and Shaughnessy (2000) conducted a study to evaluate students' understanding of central tendency regarding the concepts of arithmetic mean and median. In their research, it was reported that only one-third of the students were able to determine the median given a set of unsorted data, and students did not attach importance to calculating the arithmetic mean and median. Statistics is a method. It is very important that the contexts used in teaching statistics should be related to daily life situations and problems. There are many studies in the literature on measures of central tendency. The results of these studies show that it is important to take an active role in all stages of the research in the process of learning these subjects (Gal, 2000; Van de Walle et al, 2013; Yılmaz, 2019), that it is necessary to evaluate the research process as a whole (Randall, 2006) and that shows that it would be beneficial to include research questions in the process (Randall, 2006; Van de Walle et al, 2013).

In the creative drama process, students produce creative ideas by using statistical information on real life situations that they might not encounter otherwise. They can play a role in a fictional world created with creative drama and produces and discusses statistical creative ideas in that role. Creative drama is used to reflect and experience real situations. Students generate and discuss ideas both having fun and taking part in dramatic fiction. The effects of the delivery of mathematics teaching through creative drama providing student-centred learning environment on both students' achievements and attitudes have been well established in the literature. According to the results of the meta-analysis studies, it has been concluded that the creative drama method is a very

effective method in increasing mathematics achievement (Alacapınar & Uysal 2020, Cantürk-Günhan 2016). At the same time, it is a method that supports students' desire to research, question, wonder and explore (Adıgüzel, 2019) and increases the possibility of the learner to make the information meaningful and useful (Bowell & Heap, 2019). From this point of view, the use of creative drama method in the teaching of central tendency measures, in which it is important to actively participate in the process and make sense of the concepts, will be effective.

An example lesson plan was prepared according to the drama process for teaching central tendency is given below. Teaching measures of central tendency through creative drama by pre-service elementary school teachers, a 3-class hour lesson plan was developed to address the objectives of "*Finds and interprets measures of central tendency belonging to a data group", "Creates and interprets graphs", "Develops a strategy to solve a mathematical problem*". The situation, which was considered on the basis of dramatic scene, was inspired by the problem of The Summer Jobs Problem (Johnson & Lesh 2003). The dramatic situation takes place in an amusement park. In the warm-up activity, there is an activity that motivates, provides mental and physical warming, accompanied by the most played music in amusement parks. Role play/improvisations part, due to financial difficulties experienced by an amusement park business dismissal is discussed. At this stage, students are given two different tables. In the first table, the groups of employees' data for previous year presented that were put forward by the participants in the second activity. This data shows the money they brought to the business last summer (June, July, and August) at different densities (very, moderately, little). The second table gives the results of a survey conducted in the park last year. It shows the answers to the question "*Which one would you like to buy most in the park?*", "*What is expected from the participants is that they make defences by data in tables and their life experience for stay work*". During the reflection and evaluation phase, they are asked to solve and discuss the problem in detail. The teacher asks some questions like, "*What are the statistical concepts that you think about/use in the process and in solving the problem?*", "*Where and how did you use these concepts to work?*", "*Why did you prefer to use these concepts?*". The statistical concepts, scientific methods, the graphs are discussed at that moment. The activities were developed and implemented by the researchers. After implementation, the lesson plan has been finalized its final form.

A Sample Creative Drama Lesson Plan

Course: Mathematics

Place: Drama Workshop

Subjects: Measures of central tendency (arithmetic mean, median, mode)

Group: 18-20 participants, aged at 18-22

Duration: 120 minutes (40+40+40)

Techniques: Creative drama (improvisation, role-play, the teacher's having a role, simultaneous improvisation, consciousness corridor, still image)

Materials: Paper, pen, calculator, proper music song

Pre-requisite: Having knowledge about measures of central tendency

Objectives:

➢ Finds and interprets measures of central tendency belonging to a data group.

➢ Creates and interprets graphs.

➢ Develops a strategy to solve a mathematical problem.

Drama Process:

Preparation/Warm-up

1st Activity: (Amusement park instruments) (15 minutes)

Participants form a circle. Five groups are formed by counting to 5 consecutively. The teacher asks the participants, in small groups, to animate an instrument in the amusement park with motions and sounds. First, all the groups enact in turn, then all the groups enact simultaneously (with the accompaniment of proper music song).

Interim evaluation: Participants perform their animations in order. The teacher guides the process by asking question "Which instrument it is?", "What is your opinion?" and participants try to find out animated instrument.

Role Play/Improvisations

2 nd Activity: (Amusement park peddlers) (15 minutes)

The participants roam freely in the area. The teacher says, "*This is an amusement park and you are a peddler working in this park. Choose a role and product for yourself and now sell that product with a slogan in that role.*" All the participants improvise simultaneously. The participants become still images with the instruction of the instructor. The teacher randomly touches the shoulders of the participants and asks them to act out their roles (with the accompaniment of proper music song). All the participants act out, in turn.

3rd Activity: (Amusement park peddlers and business owner) (60 minutes)

The teacher in his role and says; "*Dear employees, as you know, I started this business in this amusement park last summer. You are travelling around the park and selling popcorn, ice cream, boiled corn, nuts, toys and fruit juices. We had a very good season last year thanks to your efforts. There has been a serious decrease in the number of customers coming to our park this summer. We are having a hard time paying your salaries and striving to survive the business. A total of 18 people work in the sale of six different products. This year, I will continue on my way with 12 employees who will work in the sale of only 4 products in the park. I'm having a hard time deciding which products to abolish and who to lay off. All I want is to be fair and not to offend anyone. I'm asking you to defend yourself that I shouldn't fire you. Now you have the word*".

Each group gives a name to the business owner. Participants improvising in the same peddler role from the previous event come together and act out one after the other with justifications to defend themselves (The trainer makes an arrangement in such a way that the peddlers mentioned in Table 1 are in the role).

The teacher is in the role again and says *"I have listened to all. My accountant analyzed last year's records and tabulated the revenue from the sale of each product group according to how crowded the park is. As you know, we tried to determine a tendency by asking children visiting the park "What product would you most like to buy?" I want to make the right decision for the business"* and thus asks the groups to examine the data and wants to make his decisions on more scientific grounds.

Calculators, table1, table 2, paper and pencils are distributed to the participants. They are given time to rethink the data.

Table 1. Revenue Created for the Business Last Year (Turkish Lira)

How crowded the park is / Product Group	JUNE			July			August		
	Very	*Moderately*	*Little*	*Very*	*Moderately*	*Little*	*Very*	*Moderately*	*Little*
Popcorn	1600	780	252	699	758	835	1788	1732	1462
Ice cream	1074	874	906	4612	2032	477	4500	3534	2712
Boiled corn	1047	667	184	1389	804	450	1862	1006	950
Nuts	1263	1188	765	1584	1468	149	1900	1276	1158

Toys	1264	1172	300	2477	681	548	2000	1130	950
Fruit juices	1115	878	574	2972	2399	231	1822	1594	577

Table 2. Results of the Survey Conducted Last Year

Answers to the question "Which one would you like to buy most in the park?"	
Popcorn	452 (n=2200)
Ice cream	561 (n=2200)
Boiled corn	358 (n=2200)
Nuts	340 (n=2200)
Toys	523 (n=2200)
Fruit juices	429 (n=2200)

After the participants work on the data in groups, the teacher is in the role again and says "*now it is the time to decide*" and listens to the peddler groups' arguments.

After listening to the arguments, the business owner tries to make a decision.

Interim evaluation: The teacher guides the process by asking questions; "*Which justifications emerged in the process? Which product group should be discontinued this year on the basis of these justifications?, Would the owner of the park act fairly?, Which product group should be discontinued when we use scientific methods? What methods did you use during this process*?"

Reflection and Evaluation (30 minutes)

For the evaluation process, the teacher asks the participants to fill in the reflective forms prepared for the process. Following questions are placed in the form.

➢ Explain your solution in detail.

➢ What are the statistical concepts that you think about/use in the process and in solving the problem?

➢ Where and how did you use these concepts to work? Please explain in detail.

➢ Briefly describe these concepts.

➢ Why did you prefer to use these concepts? Please explain in detail.

➢ Explain why you did not use some concepts related to measures of central tendency.

➢ Did you use graphs? Why and which one?

➢ What are your general views on the process?

➢ What are the stages that you followed easily in the process? Explain why.

➢ What are the stages in the process that you have difficulty with? Explain why.

➢ Explain the importance of scientific methods.

A class discussion is made together and a general evaluation is made on the filled form.

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