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A Look at the Processes of Developing Math Activities: Pre-service Primary Teachers

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Abstract

Activities, which are defined as activities that support students' mathematical learning and increase their levels of mathematic learning, enable the individual to be active by mentally and physically engaging in an action, to establish a cause-effect relationship, and to satisfy his/her curiosity. In this respect, activities have an important effect on the attitude towards mathematics. For this reason, it was aimed to examine the math activity preparation processes of pre-school primary teachers in the current study. To this end, the study was designed in accordance with the case study design, one of the qualitative research methods. In the analysis of the collected data, content analysis was employed. As a result of the study, it was found that the pre-service teachers prepared the activities themselves, they used books and the internet during the development process, and they prepared the activities for the introduction and ending sections of the lesson. In addition, it was observed that while preparing the activity, they considered its suitability for the level of the students and for the purpose of the lesson, they did not take into account individual differences while preparing the activities, and they made use of daily life examples in the activities. The pre-service teachers stated that they had difficulties in preparing activities suitable for the level of the students and stated that they did not consider themselves adequate in preparing activities. Therefore, more emphasis should be placed on improving the skills of developing activities suitable for primary school mathematics lessons in teacher training faculties.

Keywords: Activity, Activity Preparing, Primary School Mathematics, Pre-Service Primary Teacher

1. Introduction

Over time, social, economic and technological changes have brought about changes in educational paradigms and made it necessary to experience various developments. In the educational process, it has become important for the student to take part in a process related to the targeted content, to reach and construct the information himself/herself, and therefore to present experiences to the student. It is possible for the student to be an active participant in the learning-teaching process through learning activities. Activities and simulations and activity-based lessons are teaching techniques that support the constructivist philosophy (Garfield, 1995; Garfield & Ahlgren, 1988; as cited in Miller, 2002). The reason for this is that activities support the student to be mentally and physically active in the learning process and contribute to the learning process by making them engaged in an

action (Özgen & Alkan, 2014). Activities are works that are developed with educational activities and educational suggestions and that adults think are effective in learning (Burgess, 1971). MacDonald (2008), on the other hand, defines activity as a set of tasks on which learning is based, that support students' learning and increase the learning level in general. Activity production is a process that requires creativity along with the habit of thinking differently. Therefore, superficial thinking, asking a simple question, or solving a simple problem is not an activity (Bukova Güzel & Alkan, 2005). For a work to be an activity in the learning process, it must have certain characteristics. Doyle (1988) explained the prominent features of the concept of activity as follows:

- Activity should include interesting and important educational work,
- Activity includes a set of works carried out using some tools and resources,
- Activity aims to obtain a product that meets the pre-determined targets,
- Activity requires students to participate actively by taking responsibility.

It is undoubtedly important in the context of every lesson that students take responsibility for their own learning and actively engage in some activities in line with the target. However, it can be stated that activity-based learning has a special importance especially in mathematics lessons. Mathematics requires effort (National Mathematics Advisory Panel, 2008; as cited in Van de Walle, Karp & Bay-Williams 2013). According to Simon et al. (2010), children learn from an early age by participating in various activities such as counting, matching and sharing. Therefore, it is necessary to learn mathematics through activities. Math activities are at the centre of students' learning as they give messages to students about what mathematics is and what mathematics requires (National Council of Teachers of Mathematics [NCTM], 1991; as cited in Henningsen & Stein, 1997). In this context, math activity is defined as the goal-oriented mental and physical actions of students trying to achieve a certain math task (Simon et al., 2010).

Students' learning is affected by math activities (Christiansen and Walther 1986). Therefore, math activities play an important role in students' opportunities to learn mathematics (Stylianides & Stylianides, 2008). Students get primary opportunities to experience mathematics as a discipline in the classroom activities they participate in (Henningsen & Stein; 1997). Math activities that require higher order thinking and include interpretation and analysis enable students to reason about mathematical ideas (Van de Walle et al., 2013). Thus, students develop their perceptions of what it means to 'do the math' from their actual experiences with mathematics (Henningsen & Stein, 1997). Given the importance of math activities in learning mathematics, it can be said that math activities positively affect learning by supporting doing mathematics.

When the studies on this subject, which is important in learning mathematics, are examined, it is seen that the activities in the mathematics textbooks have been examined (Arslan & Özpınar, 2009; Kerpic, 2011), the effect of the teacher on the quality of math activities has been investigated (Açıl, 2011; Bozkurt, 2012; Guberman & Leikin, 2013; Leikin & Levav-Waynberg, 2007; Karakuş & Yeşilpınar, 2013; Özgen, 2019; Özgen & Alkan, 2011; Özgen & Alkan, 2014; Öztürk & Işık, 2018; Toprak, Uğurel & Tuncer, 2014; Uğurel, Bukova- Güzel & Kula, 2010) and the activities have been examined from the eyes of students (Yorulmaz, Kılıç, Ünsal & Çokçalışkan, 2020; Kılıç, Ünsal & Yorulmaz, 2020). When the studies are generally evaluated, it is seen that the textbooks are not capable of supporting higher order thinking skills, and that the studies in which math activities are investigated in the context of teachers are mostly done with mathematics teachers and pre-service mathematics teachers. On the other hand, the number of studies conducted with the participation of primary school teachers and pre-service primary teachers is low.

However, since students learn mathematics through mental and physical activities in classroom environments based on doing mathematics, class teachers are the most important determinant of a qualified mathematics education (Simon et al., 2010). According to Thompson (1992), the situation that embodies a teacher's understanding of mathematics, learning mathematics and how he/she can teach it is the way through which a math activity is presented, developed, studied and brought to a conclusion. Developing and implementing a good and effective activity for students is important in terms of increasing students' motivation towards the lesson and creating an enjoyable environment especially for primary school students. For this reason, the design of pre-service

teachers' math activities and the examination of their opinions during the design process have an important place in terms of providing information about the practices they will do as a teacher in the future. In this connection, in the current study, it is aimed to examine the math activity preparation processes of pre-service primary teachers. To this end, the research problem of the study is worded as follows; "How are the activity preparation processes of pre-service primary teachers?"

2. Method

2.1 Research Design

In the current study, which was carried out to evaluate the mathematics activities prepared by the pre-service primary teachers within the context of their undergraduate education, the case study design, one of the qualitative research designs, was used. Case study is used to obtain in-depth information about the research topic and to make it possible to understand it in its all aspects (Merriam, 1998). It is a method in which case-based data collection methods are examined in depth. Since the data were obtained based on the math activities prepared in the current study, the study was carried out using the holistic single case design.

2.2 Participant

In the current study, which was carried out to evaluate the math activities prepared by the pre-service primary teachers within the context of their undergraduate education, the study group was constructed by using purposive sampling. The study group of the current research is comprised of a total of 16 senior pre-service teachers (11 females and 5 males) attending the Department of Primary School Teaching of two state universities located in the Aegean and Black Sea Regions of Turkey in the spring semester of the 2020-2021 academic year. The criteria used in the selection of the participants were being a senior student in the Department of Primary School Teaching and being easily accessible. Before the study, voluntary consent forms were obtained from the 16 pre-service primary teachers who participated in the study.

2.3 Data Collection Tools

In the study, data were collected with a semi-structured interview form and activity plans. The interview form was preferred because it is a powerful method in revealing the knowledge, experience, feelings and perceptions of individuals. In order to prepare the data collection tool to be used in the study in line with the purpose of the study, a literature review was conducted, and it was determined that the semi-structured interview form used by Öztürk and Işık (2018) would be appropriate and would serve the purpose. The necessary permissions for the semi-structured interview form to be used were obtained from the researchers. The semi-structured interview form consists of 12 questions aiming to reveal the knowledge and experiences of the pre-service teachers regarding the activity preparation process. The layout of the activity plans used in the research process was prepared by the researchers in order for it to be more understandable by the participants and given to the pre-service teachers to prepare the activity. The layout of the activity plan consists of the name of the activity, the objective of the activity, the purpose of the activity, the duration of the activity, the type of the activity, the place where the activity will be held, the materials to be used and the activity process.

2.4. Data Collection Procedures

The data collection process of the study, which was conducted to determine the math activities prepared by the pre-service primary teachers, was carried out in two stages. First, the pre-service primary teachers were informed about the purpose of the study, a study group was randomly formed among those who wanted to participate, and participant consent forms were obtained. In the first stage of the data collection process, activity plan templates prepared electronically were sent to the 16 pre-service primary teachers who participated in the study. The pre-service primary teachers were given six days between April 28 and May 4, 2021 to prepare three activities in line with the determined objectives. The determined 8 objectives are included in the geometry learning area in the

primary school mathematics curriculum at each grade level, and each objective was given to two pre-service teachers. The pre-service teachers prepared three different activities related to the given objective. The prepared activities were collected from the pre-service teachers via electronic media. After the activities prepared by the pre-service primary teachers were completed, the second stage of the data collection process was initiated. At this stage, the semi-structured interview form was applied to the participants by the researchers. Interviews were conducted with the pre-service teachers by both researchers between 5 and 8 May 2021. Appointments were made for the interviews to be conducted to reveal the preparation process of the activities with the participants for the appropriate times and one-on-one interviews were made with each pre-service teacher using remote interview technologies and they were recorded. The average duration of the interviews was 11 minutes and 25 seconds. Then the interview records were transcribed by the researchers.

2.5. Data Analysis

Content analysis was used in the analysis of the data collected during the research process. The reason for using content analysis is to reveal the concepts and the relationships between these concepts in the explanation of the data and to express the data with the themes (Yıldırım & Şimşek, 2016; Patton, 2014). Before starting the analysis process, the real names of the participants were hidden and the codes “Ö1, Ö2, Ö3, ...” were given. In the current study, written documents consisting of raw data containing the data obtained in line with the questions in the interview form were analyzed separately by two researchers and draft themes and codes were created. The inter-coder reliability of the generated codes was calculated using the formula “Agreement / (Agreement + Disagreement) x 100” proposed by Miles and Huberman (1994), and the value of 86% was found, which is at an acceptable level. The researchers carried out the reanalysis process on the different encodings and arrived at an agreement. The codes and themes obtained are presented in tables in the findings section in line with the interview questions. In order to ensure reader confirmation, the opinions related to the coding are given as quotations.

3. Results

The findings obtained with the interview form in the current study, which was carried out with the aim of evaluating the activity preparation processes of pre-service primary teachers for primary school mathematics, are given below. The findings obtained from the question asked to determine the preferences of the pre-service primary teachers in the activity preparation process are given in Table 1.

Table 1: The pre-service primary teachers' opinions about their preferences in the activity preparation process

Category	Code	Pre-service primary teacher	f
Activity preparation	Original activity	Ö1, Ö4, Ö5, Ö6, Ö12, Ö13, Ö14, Ö15	8
	Performing effective teaching	Ö6, Ö8, Ö9, Ö10	4
	Lack of ready-made activities	Ö3, Ö7	2
Using ready-made activities	Activity preparation takes long time	Ö2	1
	Existence of activities suitable for the subject	Ö11	1

According to Table 1, while preparing the math activities, 14 of the pre-service primary teachers preferred to create the activities themselves and 2 of them preferred to use ready-made activities. It is seen that 8 of the pre-service primary teachers preferred to create their own activities as they wanted to present an original activity to their students, 4 of them preferred to create their own activities to perform effective teaching and 2 of them preferred to create their own activities because they could not find ready-made activities. The reasons stated by the pre-service teachers for their using ready-made activities are that preparing activities takes long time (f=1) and that there are activities suitable for the subject to be taught (f=1). The pre-service teacher coded as Ö5 expressed that he/she created his/her own materials to present original activities to students as follows: “I did not copy the activities directly from the internet. I wanted to think about it because as a pre-service teacher we need to develop ourselves, so I wanted to create my own activities. Thus, I wanted to add new activities to the existing ones. The

reason why I preferred this was to create original activities to avoid repeating what had already been done. Before creating the activities, I first examined the pre-created activities related to the topic I would teach. I created my activities by analyzing which activity would be more suitable for the student level.” The pre-service primary teacher coded as Ö2 explained that he/she used ready-made activities because the preparation of the activities would take a long time as follows; “I used ready-made materials because I did not have enough time to create a large number of creative activities. Thus, I looked at the relevant parts from a book that I had purchased before, which included activities for all math objectives of different grade levels.” The findings related the resources that the pre-service primary teachers used during the activity preparation process are given in Table 2.

Table 2: The pre-service primary teachers’ opinions about the resources they used in the activity preparation process

Category	Code	Pre-service primary teacher	f
Internet	Websites	Ö1, Ö5, Ö6, Ö7, Ö8, Ö10, Ö11, Ö12, Ö14, Ö15, Ö16	11
Book	Math textbook	Ö3, Ö4, Ö11, Ö13, Ö14, Ö16	6
	Math curriculum	Ö6, Ö7, Ö13, Ö15, Ö16	5
	Math teaching book	Ö2, Ö6	2
Close circle	Friend	Ö15	1
I did not use any resource	I did not use	Ö9	1

According to Table 2, 11 of the pre-service primary teachers benefited from the internet, 13 from books, and 1 from their close circle during the activity preparation process. One pre-service teacher stated that he/she did not use any resources while preparing the activity. All of the pre-service primary teachers who used the internet in preparing the activity stated that they benefited from websites; of the pre-service teachers using books, 6 used mathematics textbooks, 5 mathematics curriculum and 2 mathematics teaching book, and the pre-service teacher who stated that he/she got help from his/her close circle got help from a friend. The pre-service teacher coded as Ö8 explained how he/she used websites in preparing activities as follows; “Before creating my activities, I looked at the activities that had been done on this subject before. I looked at these from websites such as eğitim hane, YouTube, pinterest. After looking at the activities in these websites, I created my own activity in my mind. I made sure that my activity would be appropriate for the level of the student. In this process, I tried to create simple but effective activities so that the students could get the most out of the activity.” The pre-service teacher coded as Ö13 expressed how he/she used the mathematics curriculum and textbook as follows; “I examined the objectives in the mathematics curriculum and textbook.” The findings related to the aims of the activities prepared by the pre-service primary teachers are given in Table 3.

Table 3: The pre-service primary teachers’ opinions about the aims of the activities they prepared

Category	Code	1 st Activity	2 nd Activity	3 rd Activity	f
Introduction to the lesson	Comprehension	Ö1, Ö2, Ö3, Ö4, Ö5, Ö9, Ö12, Ö13, Ö15, Ö16	Ö1, Ö5, Ö6, Ö8, Ö9, Ö11, Ö12, Ö14	Ö1, Ö7	20
	Concretization	Ö7, Ö8, Ö11, Ö14	Ö4, Ö7	Ö3, Ö11, Ö14	9
	Reinforcement	Ö6	Ö3, Ö15	Ö2, Ö6, Ö13	6
Ending the lesson	Evaluation	Ö10	Ö2, Ö8, Ö13, Ö16	Ö4, Ö5, Ö8, Ö12, Ö15, Ö16	11
	Interdisciplinary transfer			Ö9	1

When the three math activities written by the pre-service primary teachers are examined in Table 3, it is seen that they wrote 29 introduction activities and 18 ending activities. When the instruction activities were examined, it was determined that the aim of 20 activities is comprehension and that of 9 activities is concretization. When the aim of the ending activities was examined, it was seen that 11 were prepared for evaluation, 6 for reinforcement

and 1 for interdisciplinary transfer. It was revealed that the math activities written by the pre-service primary teachers are more oriented towards comprehension and evaluation. When the aim of the three activities was examined, it was seen that the first activities written by the pre-service primary teachers are mostly oriented towards comprehension and the third activities are oriented towards evaluation. The pre-service teacher coded as Ö15 explained that the aim of the first activity is comprehension as follows; “*Students explore the cube, square and rectangular prisms around them and find common and different aspects of them.*” The pre-service teacher coded as Ö7 explained that the aim of the second activity is concretization as follows; “*Draws shapes according to the line of symmetry.*” The pre-service teacher coded as Ö15 explained that the aim of the second activity is concretization as follows; “*Students find the elements of cube, square and rectangular prisms and discover similar and different aspects based on their properties.*” The pre-service teacher coded as Ö15 explained that the aim of the third activity is evaluation as follows; “*Students examine cube, square and rectangular prisms through animations and write their properties on the table to find similar and different aspects.*” The findings related to the situations that the pre-service primary teachers considered in the activity preparation process are given in Table 4.

Table 4: The pre-service primary teachers’ opinions about the situations they considered in the activity preparation process

Opinions	Pre-service primary teachers	f
Student level	Ö1, Ö3, Ö4, Ö5, Ö6, Ö7, Ö8, Ö9, Ö11, Ö13, Ö14, Ö15, Ö16	13
Compliance with the purpose	Ö1, Ö4, Ö6, Ö7, Ö8, Ö10, Ö12, Ö13	8
Being interesting	Ö3, Ö4, Ö8, Ö9, Ö10, Ö12	6
The student’s being active	Ö3, Ö5, Ö6, Ö13, Ö15	5
Making effective teaching possible	Ö1, Ö16	2
Being applicable in the educational environment	Ö2, Ö8	2
Being related to daily life	Ö3	1
Including concrete materials	Ö7	1

When the situations taken into consideration by the pre-service primary teachers participating in the current study in the process of preparing mathematics activities were examined, it was found that the student’s level was the situation most taken into consideration ($f=13$). The other situations taken into consideration in the activity preparation process are compliance with the purpose ($f=8$), their being interesting ($f=6$), the student’s being active ($f=5$), making effective teaching possible ($f=2$), being applicable in the educational environment ($f=2$), being related to daily life ($f=1$) and including concrete materials ($f=1$). In the prepared math activities, the pre-service primary teachers paid more attention to the level of the student, their compliance with the purpose, their attractiveness and the student’s being active.

The pre-service teacher coded as Ö1 explained that the student level, compliance with the purpose and being interesting should be taken into consideration while preparing activity as follows; “*Students’ levels, the effectiveness of the activity I will prepare and its compliance with the purpose.*” The pre-service teacher coded as Ö5 explained that the student level and the student’s being active should be taken into consideration while preparing an activity as follows; “*I made sure it was suitable for the student level and simple but effective.*” The pre-service teacher coded as Ö8 explained what should be taken into consideration in the activity preparation process as follows; “*I paid attention to what the given objective wanted me to give to students. I took the student level into consideration. I made sure that the activity I was going to do would be applicable. At the same time, I considered whether it would be found interesting by the student.*” The findings regarding the works performed by the pre-service primary teachers to determine the appropriateness of the activities they prepared for the level of the student are given in Table 5.

Table 5: The pre-service primary teachers' opinions about the works they did in order to determine the suitability of the activities they prepared for the level of the student

Category	Code	Pre-service primary teachers	f
Book	Mathematics curriculum	Ö5, Ö6, Ö8, Ö13, Ö15, Ö16	6
	Mathematics teaching book	Ö9, Ö11, Ö12	3
	Mathematics textbook	Ö2, Ö3	2
Close circle	Sibling	Ö3, Ö4	2
	Friend	Ö6	1
Internet	Education platforms	Ö3, Ö7, Ö15	3
Finding materials	Concrete materials for the level	Ö1, Ö7	2
I did not look at the suitability for the level	I did not do any activity	Ö10, Ö14	2

As can be seen in Table 5, the pre-service primary teachers paid attention to books (f=11), close circle (f=3), internet (f=3) and finding materials (f=2) in order to determine whether the math activities they prepared are suitable for the student level. In the book category, it was determined that 6 pre-service teachers used the mathematics curriculum, 3 pre-service teachers used the mathematics teaching book and 2 pre-service teachers used the mathematics textbook. Two of the pre-service teachers in the close circle category aimed to determine the suitability of the activity for the level of the student with the help of their siblings and 1 with the help of a friend. In addition, it was revealed that 2 pre-service primary teachers did not perform any work in order to determine the suitability for the student level in the mathematics activities they prepared. The pre-service teacher coded as Ö4 explained how he/she attempted to determine the suitability of the activities prepared for the student level as follows; *"Since my brother is a 3rd grader, I had short conversations with him/her and tested whether he/she liked it."* The pre-service teacher coded as Ö15 explained his/her opinion as follows; *"I conducted research on grade levels and objectives. I searched for similar activities on the internet."* The pre-service teacher coded as Ö11 explained his/her opinion as follows; *"I resorted to mathematics teaching books."* The findings related to what the pre-service primary teachers did to take into account individual differences during the activity preparation process are given in Table 6.

Table 6: The pre-service primary teachers' opinions about taking individual differences into account in the activity preparation process

Opinions	Pre-service primary teachers	f
I did not take into consideration	Ö3, Ö7, Ö9, Ö11, Ö12, Ö14, Ö15, Ö16	8
Forming groups in compliance with the students' levels	Ö1, Ö4, Ö5	3
Activities fostering multiple intelligences	Ö2, Ö8, Ö13	3
Activating multiple sense organs	Ö6, Ö10	2
Using concrete materials	Ö1	1

When the pre-service teachers' state of taking individual differences into consideration is examined in Table 6, it is seen that many of them did not take individual differences into consideration (f=8). The remaining pre-service teachers took individual differences into consideration in the activity preparation process, by forming groups in compliance with the students' levels (f=3), using activities that foster multiple intelligences (f=3), activating multiple sense organs (f=2) and using concrete materials (f=1). The pre-service teacher coded as Ö4 explained that he/she did not take individual differences into consideration in the prepared activities as follows; *"Frankly, I do not have direct information about the developmental characteristics and individual differences of the students in my class, since I am not in face-to-face contact with the class. That's why I prepared the activity on the basis of my general knowledge."* The pre-service teacher coded as Ö8 explained his/her opinions as follows; *"Considering intelligence, I prepared an activity that includes visual, verbal, physical and social intelligence."* The pre-service teacher coded as Ö10 explained his/her opinion as follows; *"I prepared the activities in such a way as to take into account the individual differences of the students and paid attention for the activities to appeal to different sense"*

organs.” The findings regarding what the pre-service primary teachers did to make the activities they prepared related to daily life are given in Table 7.

Table 7: The pre-service primary teachers’ opinions about what they did to make the activities they prepared related to daily life

Opinions	Pre-service primary teachers	f
Daily life examples	Ö1, Ö3, Ö4, Ö6, Ö7, Ö8, Ö15, Ö16	8
Daily life materials	Ö3, Ö4, Ö5, Ö6, Ö9, Ö10, Ö14, Ö16	8
Daily life problems	Ö12, Ö13	2
I did not relate the activities to daily life	Ö2, Ö11	2

As can be seen in Table 7, the pre-service primary teachers used daily life examples ($f=8$), daily life materials ($f=8$) and daily life problems ($f=2$) to relate mathematics activities to daily life. Daily life examples and materials were used a lot in activities created by the pre-service teachers to relate the activities to daily life. On the other hand, 2 pre-service primary teachers stated that they could not establish a relationship with daily life in the mathematics activities they prepared. The pre-service teacher coded as Ö9 explained how he/she related the activities to daily life materials as follows; *“I chose materials that students use in daily life. I have increased retention with the materials that they may encounter in their daily lives.”* The pre-service teacher coded as Ö15 explained how he/she related the activities to daily life as follows; *“I wanted the students to establish relationships with the places they live and give examples from their own homes.”*, and the pre-service teacher coded as Ö5 explained his/her opinion as follows; *“In one of my activities, I showed one of the pictures they created in daily life. This was a simple picture they drew in their visual arts class.”* The findings regarding the determination of the situations in which students may experience difficulties and misconceptions in the activities prepared by the pre-service primary teachers are given in Table 8.

Table 8: The pre-service primary teachers’ opinions about the determination of the situations in which students might experience difficulties and misconceptions in the activities they prepared

Opinions	Pre-service primary teachers	f
I used my knowledge and experience	Ö1, Ö2, Ö4, Ö5, Ö6, Ö7, Ö8, Ö9, Ö12, Ö13, Ö14, Ö16	12
They would not experience difficulty and misconception	Ö3, Ö10, Ö11, Ö15	4

As can be seen in Table 8, the pre-service primary teachers used their knowledge and experience ($f=12$) in determining what difficulties and misconceptions students might experience in the mathematics activities they developed. On the other hand, 4 pre-service primary teachers stated that they were sure that the students would not experience difficulties and misconceptions in the mathematics activities they prepared. The pre-service teacher coded as Ö15 explained his/her opinion about the determination of the difficulties and misconceptions the students might experience as follows; *“I preferred to give separate instructions rather than giving them as a whole so that the students would not feel confused.”* The pre-service teacher coded as Ö3 explained his/her opinion as follows; *“If there had been a situation where a misconception would occur in the activity, I could have immediately noticed it and given feedback.”*

The findings related to the classroom organization preferred by the pre-service primary teachers to implement the activities they prepared are given in Table 9.

Table 9: The pre-service primary teachers' opinions about the classroom organization preferred by them to implement the activities they prepared

Category	1 st Activity	2 nd Activity	3 rd Activity	f	Reasons
Individual work	Ö1, Ö3, Ö4, Ö9, Ö10, Ö11, Ö15	Ö3, Ö5, Ö7, Ö9, Ö10, Ö11, Ö13, Ö15	Ö1, Ö4, Ö8, Ö9, Ö10, Ö12, Ö13, Ö15	23	Individual differences (Ö1, Ö3, Ö4, Ö8, Ö9, Ö10, Ö12, Ö15)
Group work	Ö2, Ö5, Ö6, Ö7, Ö8, Ö12, Ö13, Ö14	Ö1, Ö2, Ö4, Ö6, Ö8, Ö14	Ö2, Ö3, Ö5, Ö6, Ö7, Ö11, Ö14	21	Cooperation/solidarity (Ö1, Ö3, Ö5, Ö7, Ö8, Ö11) Peer teaching (Ö4, Ö12, Ö13) Developing information technologies (Ö5) Taking responsibility (Ö6)
Whole class work	Ö16	Ö12, Ö16	Ö16	4	Easier management of the instructional process (Ö16)

As can be seen in Table 9, the highest number of activities prepared by the pre-service primary teachers included individual work organization ($f=23$). The pre-service primary teachers also included group work organization ($f=21$) and whole class organization ($f=4$) in their activities. The reason for the inclusion of individual work organization in the activities was shown to be individual differences by the pre-service teachers. The reasons for the inclusion of group work organization were shown to be cooperation/solidarity, peer teaching, developing communication skills and taking responsibility. The reason for the inclusion of whole class organization was shown to be easier management of the instructional process. The pre-service teacher coded as Ö9 explained his/her opinion as follows; “*My activities require working individually. I aimed to make it easier for each student in the classroom to engage in the materials individually and to facilitate their learning.*”; the pre-service teacher coded as Ö4 explained his/her opinion as follows; “*My aim in preparing individual activities was that they were suitable for everyone. In the group work, I wanted my students to benefit from peer teaching.*” and the pre-service teacher coded as Ö6 explained his/her opinion as follows; “*I want students to take responsibility not only for their own work but also for their friends' work.*” The findings related to the difficulties encountered by the pre-service primary teachers during the activity preparation process are given in Table 10.

Table 10: The pre-service teachers' opinions about the difficulties they encountered in the activity preparation process

Opinions	Pre-service primary teachers	f
Preparing activities suitable for the student level	Ö3, Ö11, Ö12	3
Preparing creative activities	Ö3, Ö7, Ö15	3
Finding economical materials for activities	Ö5, Ö7	2
Producing activities	Ö10, Ö14	2
Preparing activities addressing different skills	Ö2	1
Preparing activities complying with the objective	Ö3	1
Preparing activities attractive for students	Ö6	1
I did not encounter any difficulty in preparing activity	Ö1, Ö4, Ö8, Ö9, Ö13, Ö16	6

As can be seen in Table 10, the pre-service primary teachers experienced difficulties in preparing activities suitable for the student level ($f=3$), preparing creative activities ($f=3$), finding economical materials for activities ($f=2$), producing activities ($f=2$), preparing activities addressing different skills ($f=1$), preparing activities complying with the objective ($f=1$) and preparing activities attractive for students. It can be said that the pre-service teachers experienced the greatest difficulty in preparing activities suitable for the student level and preparing creative activities. In addition, 6 pre-service primary teachers stated that they did not have any difficulties in preparing mathematics activities. The pre-service teacher coded as Ö3 explained his/her opinion about the difficulties experienced as follows; “*I experienced difficulties in finding answers to such questions as “If I use this, will it be suitable for their level, will it be creative or will it be in compliance with the objective?”*”. The pre-service teacher

coded as Ö7 explained his/her opinion as follows; *“I have difficulties in finding materials, games related to some objectives. There might be times when we need to use our creativity. Then, I watch videos teaching the subject. I search for relevant games. Then, I add some creativity, then I have a good activity.”* Findings related to the pre-service primary teachers’ self-evaluation in relation to the activity preparation process are presented in Table 11.

Table 11: The pre-service primary teachers’ self-evaluation in relation to the activity preparation process

Opinions	Pre-service primary teachers	f
Adequate	Ö1, Ö2, Ö4, Ö5, Ö6, Ö7, Ö14	7
Partially adequate/inadequate	Ö3, Ö8, Ö10	3
Inadequate	Ö9, Ö11, Ö12, Ö13, Ö15, Ö16	6

As can be seen in Table 11, 7 of the pre-service primary teachers see themselves as adequate, 3 as partially adequate/inadequate and 6 as inadequate in the activity preparation process. Thus, fewer than half of the pre-service primary teachers consider themselves fully adequate. The pre-service teacher coded as Ö7 explained his/her opinion in terms of seeing himself/herself adequate as follows; *“I think I am good at preparing activities. I can come up with creative ideas.”* The pre-service teacher coded as Ö8 explained his/her opinion as follows; *“I think I am inadequate. I need to do research to conduct better activities.”* and the pre-service teacher coded as Ö12 explained his/her opinion as follows; *“I cannot tell that I have adequate knowledge about preparing activities but with this study, I have become more interested in this issue, when the necessary information is given, skills and abilities can be revealed.”* The findings related to the adequacy of the undergraduate education in terms of training pre-service teachers in activity preparation obtained are given in Table 12.

Table 12: The pre-service primary teachers’ opinions about the adequacy of the undergraduate education in terms of activity preparation

Opinions”	Pre-service primary teachers	f
Adequate	Ö1, Ö2, Ö3, Ö4, Ö5, Ö6, Ö7, Ö14	8
Partially adequate/inadequate	Ö8, Ö9, Ö10, Ö16	4
Inadequate	Ö11, Ö12, Ö13, Ö15	4

As can be seen in Table 12, 8 of the pre-service primary teachers see their undergraduate education as adequate in terms of training them in activity preparation, 4 as partially adequate/inadequate and 4 as inadequate. Thus, it can be said that half of the pre-service primary teachers see their undergraduate education as adequate, while the remaining half see it partially adequate or inadequate. The findings related to suggestions of the pre-service primary teachers to make their undergraduate education better in terms of activity preparation are given in Table 13.

Table 13: The pre-service primary teachers’ suggestions to make their undergraduate education better in terms of activity preparation

Opinions	Pre-service primary teachers	f
The number of practice-oriented studies should be increased	Ö9, Ö11, Ö13, Ö15	4
The time allocated to preparing activities in undergraduate courses should be increased	Ö12, Ö15	2
More research should be conducted on activity writing	Ö8, Ö10	2
Articles and books should be read about how to prepare math activities	Ö13	1
Individual motivation of students should be increased	Ö16	1

As can be seen in Table 13, the pre-service teachers suggested that the number of practice-oriented studies should be increased (f=4), the time allocated to preparing activities in undergraduate courses should be increased (f=2), more research should be conducted on activity writing (f=2), articles and books should be read about how to prepare math activities (f=1) and individual motivation of students should be increased (f=1) to make their

undergraduate education more adequate in terms of training them in activity preparation. The pre-service teacher coded as Ö8 explained his/her opinion about how to develop the process as follows; *“At the university where I studied, they often emphasized such skills in order to for us to master them. Since we were asked to do studies and tasks, I gained knowledge and experience. I don't think I'm inadequate, but I can do better activities by doing research.”* The pre-service teacher coded as Ö15 explained his/her opinion as follows; *“I think the time allocated to practicum teaching is not enough. I think that in order to plan an activity, it is necessary to understand the classroom environment thoroughly. We need to be in constant interaction with the class in order to apply the activities in the class and get their feedback.”* and the pre-service teacher coded as Ö10 explained his/her opinion as follows; *“So I don't remember getting a training on how to prepare an activity, but we were encouraged to do research on this and I think it worked.”*

4. Discussion

The current study employing the case study design, one of the qualitative research designs, was conducted with the participation of 16 pre-service primary teachers in order to evaluate the mathematics activities they prepared within the context of their undergraduate education. The majority of the pre-service primary teachers preferred to create mathematics activities themselves in order to present original activities to their students and to increase the efficiency of teaching. According to the results of the study, which examined the ability of pre-service mathematics teachers to create activities for the concept of function, it was concluded that pre-service teachers were able to develop activities (Özgen & Alkan, 2014). The reason why the results of the two studies are different can be attributed to the differences between the study groups. In the current study, the reason why the pre-service teachers preferred to create the activities themselves might be because they wanted their activities to be specific to the group, they thought that the activity needs of each group may be different and effective learning methods of different groups can be different.

While preparing the mathematics activities, the pre-service primary teachers mostly benefited from the books, then the internet, and the least from their close circles. While the pre-service teachers who benefited from the book benefited more from the mathematics textbook and the mathematics curriculum, those who used the internet used the websites. Toptaş (2008) found in his study on primary teachers that teachers generally use the activities in the textbooks and workbooks in geometry lessons without making students think. The findings of the two studies are similar. Based on this similarity, it can be said that the content of mathematics textbooks, which are one of the most effective guides in the preparation of activities, should be richer and contribute to the development of students' creativity and encourage them to think. However, the mathematical activities students encounter often focus on rote learning or “low cognitive tasks” (Henningesen & Stein, 1997).

When the three activities prepared by the pre-service teachers are examined, it is seen that they mostly prepared them for the purpose of introduction to the lesson and secondly for the purpose of ending the lesson. It is seen that the majority of the introduction activities for comprehension, and the majority of the ending activities are for evaluation. It was stated by the pre-service teachers that the activities prepared for understanding the subject and teaching the subject in general were intended to be used in the main stage of the lesson. In their study, Öztürk and Işık (2018) found that the aims of the pre-service mathematics teachers to develop activities are to comprehend, concretize and evaluate the subject, respectively. According to Özgen and Alkan (2014), the reason for pre-service teachers' designing mathematical activities for comprehension purposes was their theoretical closeness to the subject.

While preparing the mathematics activities, the pre-service primary teachers paid attention to their being suitable for the level of the student, being in compliance with the purpose and being attractive to students. It has been stated in different studies that the suitability of the activities used in the lessons for the level of the student is one of the most important points to be taken into account, and that it is one of the most important elements for students to accomplish the objectives in order to reach the targeted goal (Ainley, Pratt & Hansen, 2006; Stylianides & Stylianides, 2008; Toptaş, 2008). Özgen (2017), on the other hand, argues that the activities developed should be suitable for teaching purposes. According to Hannibal (1996), students should be subjected to the activities suitable

for their developmental level. If these studies are evaluated as a whole, it is seen that the pre-service teachers take into account important aspects such as suitability for the curriculum, suitability for the purpose and suitability for the level of the student during the activity preparation processes. Therefore, it can be said that pre-service teachers have knowledge about preparing activities.

The pre-service primary teachers participating in the current study mostly used books, then their close circle and the internet to determine whether the mathematics activities they prepared are appropriate for the level of the students. The pre-service teachers mostly used the mathematics curriculum and the mathematics teaching books in the category of books. Ainley, Pratt, and Hansen (2006) explained that the first of the three situations to be considered in the process of creating activities in the mathematics lesson is the consideration of the curriculum. Toprak et al. (2014) also found that pre-service teachers benefited from the curriculum the most when designing activities. Thus, it can be said that the curriculum and mathematics textbooks are important in guiding the activities prepared by teachers and pre-service teachers.

While the majority of the pre-service primary teachers did not take individual differences into account while preparing activities, the pre-service teachers who took individual differences into consideration did this by forming groups in compliance with the level of students and by preparing activities that active multiple intelligences. Öztürk and Işık (2018) found in their study that pre-service mathematics teachers did not consider individual differences in the activity preparation process. Although the study groups were in different branches, the findings similar to those of the current study could be interpreted as the lack of knowledge of the pre-service teachers about preparing activities. Brooks and Brooks (1999) state that it is a requirement for teachers to create activities suitable for the individual by considering student differences. Duran, Sidekli and Yorulmaz (2018) concluded in their study that there is a significant difference between primary school fourth grade students' attitudes towards mathematics activities and their mathematics exam grades. Thus, it can be stated that the mathematical activities prepared should appeal to students from all groups.

The pre-service primary teachers who participated in the current study mostly used daily life examples and materials to relate the activities to daily life. Some of the pre-service teachers used daily life problems to associate the activities with real life. In the study by Özgen (2019), in which pre-service teachers' skills of designing activities to associate mathematics with different disciplines were examined, it was concluded that the pre-service teachers had difficulties and that they associated mathematics in a single context. In addition, there were pre-service teachers who did not relate the activities to daily life, which is parallel to the finding of Yorulmaz and Çokçalışkan (2017) stating that mathematics could not be associated with daily life. Stein, Grover and Henningsen (1996) stated that most of the mathematical activities are not associated with daily life and remain in the abstract world of mathematics.

The majority of the pre-service teachers used their knowledge and experience in determining what difficulties and misconceptions students might experience in math activities. On the other hand, there were also pre-service teachers who thought that students would not experience difficulties and misconceptions. A similar finding was obtained in the study conducted by Öztürk and Işık (2018). Önal and Aydın (2018) stated that the causes of misconceptions that might occur in students' minds should be noticed by teachers at first, and this supports the conclusion that teachers should have knowledge and experience.

The pre-service primary teachers prepared the activities that included individual work the most, followed by the activities including group work and whole class organizations. In the study conducted on pre-service secondary school mathematics teachers, it was concluded that the pre-service teachers preferred small group work that requires collaboration and then individual work (Toprak et al., 2014). In a study in which mathematical activities were analyzed, it was stated that the majority of the activities encouraged participation in group work and whole class organizations (Stein et al., 1996). Yorulmaz et al. (2020) in their study examining the activities in primary school from the perspective of fourth grade students concluded that the students wanted to take part in activities based on group work with their peers. While the pre-service teachers pointed to individual differences as the reason for their preferring individual work organization, they pointed to cooperation/solidarity, peer teaching, developing

communication skills and taking responsibility as the reasons for their preferring group work organization and they pointed to the easier classroom management of the teaching process as the reason for their preferring whole class organization. According to Deshpande and Ahmed (2019), group or class activities are a student-centered approach that allows students to collaborate. This might have affected the pre-service primary teachers preferring to develop activities based on group work. Therefore, it can be said that the pre-service teachers have knowledge about the contributions they will make to the students with the activities they have developed.

When the pre-service teachers' opinions about the difficulties they encountered while preparing math activities were examined, it was concluded that they encountered difficulties in preparing activities suitable for the student level, in preparing creative activities, in finding economical materials to prepare activities, in preparing activities addressing different skills, in preparing activities in compliance with the objective and in preparing activities interesting to students. Özgen and Alkan (2014) stated that they encountered reflections indicating that pre-service mathematics teachers had difficulties in the activity development process. The fact that the pre-service teachers experienced different kinds of difficulties while preparing activities might indicate that they do not have enough knowledge.

Most of the pre-service primary teachers considered themselves as "partially adequate/inadequate" or "inadequate" in terms of preparing math activities. Fewer than half of the pre-service teachers considered themselves fully adequate. On the other hand, half of the pre-service primary teachers participating in the current study considered their undergraduate education adequate in terms of the activity preparation process, while the remaining pre-service teachers considered it "partially adequate/inadequate" and "inadequate." In this connection, the pre-service teachers suggested that the number of practice-oriented studies should be increased, the time allocated to preparing activities in the undergraduate courses should be increased, more research should be done on activity writing, articles and books should be read about how to prepare activities and individual motivation should be increased to improve the activity preparation process in math classes.

In light of the findings of the current study, it can be said that more importance should be given to the studies aimed at improving the activity development skills of pre-service primary teachers in their undergraduate years in accordance with the subjects of primary school mathematics curriculum. The limitation of the current study is the preparation of activities in compliance with the objectives of the geometry learning area. Within the scope of the primary school mathematics curriculum, further research in which activities suitable for other learning areas are prepared can be conducted. In further research, pre-service teachers can be given the opportunity to practice the activities they have developed for the mathematics lesson in a real classroom environment and then their opinions can be investigated.

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