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# Micro-Teaching Application Situations of Secondary School Mathematics Teacher Candidates based on Student Misconception/Difficulty

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**Abstract**
*Misconception/student difficulty is one of the student characteristics that should be known by teachers. Teachers should have effective knowledge and strategies to overcome these misconceptions and difficulties. In this sense, microteaching practices have an important place in the context of pre-service teachers' ability to increase their knowledge and strategies and their developing professional experience. The aim of this research is to examine the microteaching of primary school mathematics teacher candidates in the context of student misconceptions and difficulties. The research design is in the qualitative reserch model and the case study method was used. The research data were obtained from the analysis of semi-structured interviews with pre-service teachers, prepared lesson plans and micro-teaching video recordings. The obtained data were analyzed by content analysis method. According to the results of the research, although different strategies such as pre-service teachers, group work and class discussion were used, the most frequently used strategy was the strategy of putting students on the board and dealing with misconceptions/student difficulties through sample questions.*
**Keywords: Misconception, Student Difficulty, Pre-service Teachers, Mathematics Education, Micro-Teaching**

## Introduction

One of the important issues in the field of teacher training is undoubtedly teacher knowledge and determining what the components are. Subject matter knowledge alone is not enough to teach a concept. There is a need for some information about students' misconceptions, pre-conceptions and their developments in order to transform the subject matter knowledge beyond the subject content knowledge into teaching knowledge, in other words, to transform the lesson into a way that students can understand better (Shulman, 1986). This type of knowledge is called pedagogical content knowledge (PCK) by Shulman (1986). Pedagogical content knowledge is a different type of knowledge from subject content knowledge and is defined as the transformation of content knowledge into teaching knowledge. This type of knowledge includes knowing the ways of transforming the concept into a better understanding of the students, possible misconceptions, and knowing a lot of different information such as background information (Shulman, 1986).

Considering that students come to the classroom with their past knowledge and experiences, it is inevitable that this information will affect student learning. The fact that some of the knowledge they have acquired beforehand, which is called pre-comprehension, is not compatible with the scientific knowledge taught at school, emerges as a misconception in the student. Misconceptions are systematic errors that lead students to correct results in previous situations, but lead students to wrong solutions in the future (Brousseau, 1983; Çepni, 2016; Zembat, 2008). At this point, it is very important to know, identify and take precautions for misconceptions so that students can understand the concept correctly (Alkan & Ada, 2023; Çepni, 2016; Demircioğlu et al., 2004). When misconceptions and student errors are eliminated with educational applications prepared in accordance with the relevant concept and the student, the learning levels of the students can be increased (Güner & Alkan, 2011). On the other hand, it is inevitable for misconceptions to occur in cases where appropriate educational practices are not created in teaching concepts and these misconceptions cannot be detected in students (Ayas & Demirbaş, 1997; Lawson & Thomson, 1988). However, not every mistake is an error or a misconception (Erdem & Gürbüz, 2017). In this context, teachers should develop their ability to develop solutions by making the distinction between mistakes, mistakes and misconceptions correctly. (Demirci et al., 2017). This development will increase students' learning levels as well as their own field knowledge (Brodie, 2014). Since mathematics is a cumulative field, how each concept is learned affects the learning of the next concept. If there is an erroneous learning, this causes many concepts to be learned in the future to be misconstrued (Zembat, 2008; Önal & Aydın, 2018). Because mathematical misconceptions are concepts that are accepted by the individual, do not change easily, contradict mathematical truths and systematically encourage mistakes (Erbaş et al., 2009; Türkdoğan et al., 2015; Zembat, 2008).

Most of the studies on misconceptions in mathematics education (Anderson, 1986; Griffiths & Preston, 1992; Gürdal et al., 2001; Kathlen, 1994; Kocaoğlu & Yenilmez, 2010; Lawson & Thomson, 1988) focus on students' misconceptions. In the studies conducted at the undergraduate level, it aims to identify the misconceptions (Barak, 2007; Özkaya & İşlenen, 2012) and to reveal the reasons (Moralı, et al., 2004; Özerdem, 2007) instead of the pre-service teachers' ability to eliminate certain misconceptions. In addition to these studies, there are also studies aiming to determine the conceptual performance of the participants in mathematics teaching (Alcock & Simpson, 2004; İpek, et al., 2005). Baştürk (2009) determines teacher candidates' approaches to student error and evaluates these approaches in the light of classical, behaviorist and constructivist learning views. Boz (2004) who stated that subject knowledge is effective in understanding and analyzing students' mistakes in their study, reveal that pre-service teachers with weak subject knowledge have difficulty in diagnosing student mistakes. It is seen that mathematical errors, misconceptions and student difficulties, which are considered as an undesirable situation in related studies and frequently encountered in mathematics education research, have recently been transformed into a tool that supports students' learning in terms of teachers (Akpınar & Akdoğan, 2010; Fırat, 2011). For example, Özkaya and Konyalıoğlu (2019) state that teachers' perspectives towards mistakes develop in a more positive way in their studies where they focus on enabling teachers to see their own knowledge by making error-based practices.

Deblois's (2006) study, which is more closely related to the subject of this research and includes strategies for misconceptions, teachers describe student products within the framework of errors, analyze and synthesize how the analyzes will affect their interventions against errors. Another similar study reveals the relationship between how teachers handle student mistakes and their beliefs about these mistakes and the strategies they develop. Since PCK is a type of knowledge that generally develops with teaching experience, it is important that pre-service teachers are trained in the pre-service period by confronting this type of knowledge and its components such as misconceptions (Baxer & Lederman, 1999; Gess-Newsome, 1999; Van Driel, et al. 2001). In this sense, the aim of this research is to examine the micro-teaching practices of primary

school mathematics teacher candidates, taking into account student misconceptions and difficulties. In this study, it was tried to reveal the answers to the questions of how pre-service teachers diagnose misconceptions, what strategies they developed to eliminate them, and how they included these strategies in their lectures.

## Method

This research aims to examine the lectures prepared by primary school mathematics teacher candidates by considering possible misconceptions and student difficulties regarding the subjects in the Secondary School Mathematics Program. Since it is aimed to evaluate the pre-service teachers participating in the research as they are without any intervention to the conditions they are in; the research was designed in the qualitative research model (Karasar, 2009). The case study method was used to collect data in the research. The case study aims to determine the depth and breadth of the participants in the universe, their relations with themselves and their environment, and to make a judgment about the relevant participants (Karasar, 2009).

## Participants

16 pre-service teachers who were studying in the 3rd grade, 5th semester of the Primary School Mathematics Teaching Department and took the elective course "Misconceptions in Mathematics Education and Student Difficulties" participated in the research. Pre-service teachers' content knowledge (General Mathematics, Abstract Mathematics, Geometry, Analysis I-II, etc.), general pedagogical knowledge (Introduction to Educational Sciences, Educational Psychology, Teaching Principles and Methods, etc.) and field education knowledge (Special education) up to this grade level. Methods 1, Instructional Technologies and Material Design etc.) courses. Misconceptions in Mathematics Education and Student Difficulties course was grouped as good, moderate and poor by using maximum diversity sampling from pre-service teachers, and the data of 9 of them were analyzed and interpreted by including 3 pre-service teachers from each group in the research group. In this way, it was aimed to reveal different dimensions of the problem by participating in the research of students with different knowledge levels.

## Data Collection Tools

16 The data collection tools of this research were used by prospective teachers in Elementary Education 5-8. Lesson plans related to a topic they chose from the 3rd Grade Mathematics Curriculum, video recordings and notes of the micro-teaching lectures they applied, and video recordings of the preliminary and final semi-structured interviews about the lessons they taught. Since the data obtained from the analysis of these data collection tools are intended to be used together, there is data triangulation in the study. Elementary Education 5-8 regarding the lesson that teacher candidates will teach. For the 3 acquisitions they chose from the 3rd Grade Mathematics Curriculum, attention was paid to the fact that they chose the acquisitions with a predominant conceptual aspect rather than exercises and example solutions, especially taking into account the misconceptions.

## Data Analyses

The answers given by the pre-service teachers to the questions were subjected to content analysis. Content analysis takes place in four stages: data coding, finding categories, organizing them, defining and interpreting the findings (Yıldırım & Şimşek, 2018). After all the analysis and interpretation processes were completed, it was shown to the participants and the participant's approval was obtained for the comments. Thus, the reliability of the analysis and interpretations was tried to be increased.

## Results

In this section, there are findings related to the lesson plans and lectures prepared before the lectures on micro-teaching practices of the teacher candidates and after the lecture.

## Lesson Plan

In this section, there are findings about the lesson plans of the lessons taught by the pre-service teachers. In the lesson plans, first of all, three acquisitions that pre-service teachers discussed, possible misconceptions about these acquisitions and student difficulties were discussed.

**Table 1 The Achievements and Possible Misconceptions of Prospective Teachers-Student Difficulties**

| Partcipant | Gains | Possible Misconceptions and Students Difficulties |
|---|---|---|
| PT1 | on the subject of decimal numbers, when a whole is divided into 10, 100, 1000 equal parts, it is determined that the unit of the resulting fraction can be expressed in decimal notation | Mixing the whole and decimal part (ky1) |
| | | Misconceptions in the concept of step (ky2) |
| | Expressing a fraction with a denominator of 10, 100 or 1000 in decimal notation and understanding its relationship with the value of the whole part and the digits in the decimal part in decimal notation | Numbers can grow or shrink while multiplying (ky3) |
| | | Thinking that decimal numbers will be larger in order than multi-digit numbers (ky4) |
| PT2 | Finding the result of parenthetical expressions containing up to two types of operations | Students should think which one they will start first in operations with the same priority and follow a solution path from left to right (KY1) |
| | Performing four operations with natural numbers, taking into account the operation priority, and | |
| | Solve and set up problems that require four operations with natural numbers | Undecided whether to take the parentheses first or the exponential number in the operation priority. (ky2) |
| PT3 | Creating the image of the shapes as a result of reflection, drawing the images as a result of translation and rotation | Although the student can draw the reflection of a figure in the vertical coordinate system, they cannot draw its reflection in the oblique line (ky1) |
| PT4 | To determine the possible states of an event, | Lack of prior knowledge about probability (ky1) |
| | Distinguish “more”, “equal”, “less” portables events and give examples, | Incomplete understanding of the definitions on the Subject. (ky2) |
| | Undertstand that the probability value is between 0 and 1 (including 0 and 1), and | |
| | Calculating the probability of an simple event | |
| PT5 | Naming polygons, comparing them, comprehending their defining features | Inability to associate geometric shapes with each other (ky1) |
| | To see that it can be displayed in different ways and creating the basic elements | Inability to display shapes in different formats (ky2) |
| PT 6 | Recognizing integers, displaying them on the number line, comparing and sorting integers, determining the absolute value of an integer and making sense of it | Sorting negative and positive numbers without paying attention to the sign (ky1) |
| | | Inability to compare numbers on the number line (ky2) |
| PT 7 | To understand that the number of cubes placed inside the rectangular prism in such a way that there is no space is the volume of the injects | The student’s internalization of the volume definition only as the volume covered and perceiving the definition and the volume asked in the examples differently (ky1) |
| | Calculating the volume of a given object by counting unit cubes | Miscalculation of the volume of unit cubes based on the surface area (ky2) |
| PT 7 | Constructing different rectangular prisms with unit cubes with a given volume measure | Student’s incorrect positioning of unit cubes (ky3) |

| | | |
|---|---|---|
| PT 7 | Explain that volume is the product of the area of the base and the height, and | The misconception that the volume calculation can only be calculated with unit cubes (ky4) |
| | Constructing the volume relation of a rectangular prism and solving related problems | Do not think that the volumes of the same rectangular prism will differ if the unit changes in the volume calculation (ky5) |
| | | The idea that we can only measure the volumes of regular geometric shapes (ky6) |
| PT 8 | Performing addition and subtraction operations with algebraic expressions, multiplying a natural number with an algebraic expression, understanding the principle of conservation of equality, recognizing a first-order equation with an unknown and constructing and equation with a first-order unknown suitable for given real-life situations | Their alphabetical order as a basis when processing letter expressions (ky1) |
| | | Going to find a result wherever it sees the equal sign (ky2) |
| | | Variable/number confusion in algebraic expressions (for example, think of 3x as a two-digit number and vice versa) (ky3) |
| PT 9 | Creating the area relation of the parallelogram, solving the related problems, recongnizing the area measurement units, converting the m2-km2, m2-cm2-mm2 units and solving the area related problems. | Difficulties in converting area measurement units to each other (ky1) and misconceptions arising from not fully understanding the relationship between environment and area (ky2) |

As it can be seen in Table 1, the lectures of the teacher candidates were planned according to different acquisitions, therefore their misconceptions also differed according to the outcome. They used articles and textbooks as sources while identifying the misconceptions/student difficulties regarding the achievements of the pre-service teachers. As a result of this situation, the number of sources they obtained and the differences in the selected gains caused the data they obtained about misconceptions and student mistakes to be different. Therefore, it is seen that pre-service teachers have identified different numbers of misconceptions/student difficulties. It was determined that there was an average of 2.66 misconceptions/student difficulty per subject. PT7 mentions 6 misconceptions/student difficulties related to the subject in the lesson plan. From this, it is understood that the pre-service teacher made a detailed research. PT3 found 1 misconception/ student difficulty about his subject. In Table 2 below, the themes and codes of the strategies determined for the lesson plans prepared and cascaded by the participants are presented.

**Table 2 Themes and Codes of the Strategies Determined for the Lesson Plan Steps**

| Order | Code | Strategies |
|---|---|---|
| One | AY | Making a Statement |
| 2 | TY | Making a Definition |
| 3 | MÖV | Mathematical example giving |
| 4 | GHÖV | Giving examples from Daily Life |
| 5 | DG | Showing the Truth |
| 6 | AÇ | Practice Solve |
| 7 | KG | Showing Achievements |
| 8 | ÇTK | Using Multiple Representations |
| 9 | SS | Do not ask me question |
| 10 | KYC | Giving the Misconception |
| 11 | EY | Making an Event |
| 12 | TşY | Don't Debate |
| 13 | GÇY | Group Work |
| 14 | BÇS | Providing Cognitive Conflict |
| 15 | PK | Troubleshooting |
| 16 | TK | Using Technology |
| 17 | MK | Using Material |
| 18 | MSS | Asking Mathematical Questions |

In Table 3, the strategies determined in the lesson plans of each teacher candidate and the strategies to eliminate the misconceptions are given.

**Table 3 Distribution of Strategies to Eliminate the Misconceptions about the Course Stages**

| Teacher Candidate | Lesson Plan step number | Strategy themes used | Number of misconceptions / student difficulties | Strategies envisaged to be used in the lesson plan to eliminate the misconception/ students' difficulties | Element-themed strategies used to address misconception/ student difficulty in the lesson plan | Frequencies |
|---|---|---|---|---|---|---|
| PT 1 | 7 steps | 4 TY, 2 MÖV, 2 AÇ, 1 DG 1 SS | 4 | The student's correcting his/her own misconception from the wrong answers given by him/ herself | - | - |
| PT 2 | 10 steps | 7 MSS, 6 SS, 2 GÇY, 2 AÇ, 2 TK, 2 AY, 1 BÇS, 1 PK,1 EY, 1 TŞY | 2 | that will create cognitive conflict in students and eliminate possible mistakes and misconceptions are given. Using question-answer technique, problem solving technique, brainstorming technique | MSS, TŞY, SS (ky1) | 5 MSS<br>5 SS |
| | | | | | MSS, GÇY, SS (ky1) | 2 GÇY<br>1 TŞY |
| | | | | | MSS, SS, BÇS, (ky2) | 1 BÇS |
| | | | | | MSS, GÇY, SS (ky3) | |
| | | | | | MSS, SS, AY (ky3) | |
| PT 3 | 9 steps | 6 TY, 3GHÖV, 3 MÖV, 1KYV, 1 AÇ, 1 TŞY | 1 | solve example<br>Solving reflection examples with respect to an oblique line | KYV (ky1) | KYV |
| PT 4 | 6 steps | 2 SS, 1 GHÖV, 1 KG,1 EY, 1 MK, 1 MÖV | 2 | Associating the subject with daily life | EY, MK, MÖV (ky2) | 1 EY |
| PT 4 | 6 steps | 2 SS, 1 GHÖV, 1 KG,1 EY, 1 MK, 1 MÖV | 2 | Getting students to ask questions | EY, MK, MÖV (ky2) | 1 MK |
| | | | | using material | | 1 MÖV |
| PT 5 | 13 steps | 11 TY, 6 TY, 4 MSS,2 EY, 1MÖV,1 KYV | 2 | make an event | MSS (ky1) | 1 MSS |
| | | | | Showing shapes differently | EY (ky1) | 1 EY |
| | | | | | KYV (ky1, ky2) | 1 KYV |
| PT 6 | 11 steps | 2 GHÖV, 2 MÖV, 1 KG,1 SS 1 TŞY,1 ÇTK, 1 TK, 1 MK,1 EY | 2 | using material | TY, ÇTK (ky 1, ky 2) | 3 TY<br>1 ÇTK |
| | | | | | GHÖV (ky1, ky2) | 1 GHÖV |
| | | | | | TY, TY (ky1, ky2) | |

| | | | | | | |
|---|---|---|---|---|---|---|
| PT 7 | 41 steps | 10 AY, 9 SS, 6 MSS,4 GÇY, 3 TşY, 2 EY, 1MÖV,1 MK, 1 BÇS,1 AÇ | 6 | To have an in-class discussion about volume. | SS, TşY (ky1) | 9 SS |
| | | | | | AY, MÖV (ky1) | 8 AY |
| | | | | | GÇY, MK, EY (ky3) | |
| | | | | To reveal the perception of volume. | SS (ky3) | 5 MSS |
| | | | | | AY (ky1) | 3 TşY |
| | | | | Giving more than one definition of volume. | MSS, SS, SS, SS, AY, SS, GÇY, MSS, TşY, AY (ky2) | 3 GÇY |
| | | | | | | 1 MÖV |
| | | | | | | 1 EY |
| | | | | Using material. | GÇY, MSS, AY (ky2) | 1 MK |
| | | | | | AY, MSS, GÇY, SS, AY (ky4) | |
| | | | | | MSS, SS,TşY, SS, BÇS (ky4) | |
| PT 8 | 14 steps | 6MÖV,3 AY, 3 MK,3 EY, 4 MSS,2 TY, 1 SS, 1 GHÖV, 1 TşY | 3 | Using material. | SS, Tşy, MK, EY, MÖV, MK, AY (ky2) | 2 MK |
| | | | | | | 2 MSS |
| | | | | | | 2 MÖV |
| | | | | | MÖV, MSS (ky2) | 1 SS |
| | | | | | MSS | 1 TşY |
| | | | | | | 1 EY |
| | | | | | | 1 AY |
| PT 9 | 12 steps | 4 TY, 2 MSS,2 EY 2 AY,2 AÇ 1 KG, 1 MK,1 MÖV,1 SS | 2 | Using the way of discovery and enabling students to find the truth by contradicting themselves | EY, SS (ky1) | 2 AÇ |
| | | | | | TY, AY, AÇ, AÇ (ky2) | 1 AY |
| | | | | | | 1 SS |
| | | | | | | 1 EY |
| | | | | | | 1 TY |
| Total | | 33 TY, 23 MSS, 21 SS, 17AY, 16MÖV, 12 EY,8 AÇ 7GHÖV, 7 TşY, 7 MK 6 GÇY,3 TK, | 24 | | | 16 SS |
| | | | | | | 13 MSS |
| | | | | | | 11 AY |
| | | | | | | 6 GÇY |
| | | | | | | 5 EY |
| | | | | | | 5 TşY |
| | | | | | | 4 MK |
| | | | | | | 4 MÖV |
| | | | | | | 4 TY |
| | | | | | | 2 BÇS |

| | | | | | | |
|---|---|---|---|---|---|---|
| Total | | 3 KG,2 BÇS, 2 KYV,1 DG, 1 PK,1 ÇTK | 24 | | | 2 KYV<br>1 ÇTK<br>1GHÖV |

A total of 184 strategies were used in the lesson plans created by the pre-service teachers focused on misconception/student difficulty. Among these strategies, it was determined that the strategy of making definition (17.93%) was used the most, while the least used strategies were showing the truth (0.54), posing a problem (0.54) and using multiple representations (0.54). When it is considered in general terms of pre-service teachers, it is seen that the pre-service teacher who uses strategies the most (20.65%) and uses the strategies in the most variety (10 types) is PT7, while the pre-service teacher who uses the least strategy (3.80%) is PT4, the least It was determined that the teacher candidate who used various strategies (5 types) was PT1. While PT1, PT3, PT5 and PT9 use the strategy of defining the most, the strategies most used by other teacher candidates show differences. The strategy of having a discussion was the least used common strategy by PT2, PT3, PT6, and PT8.

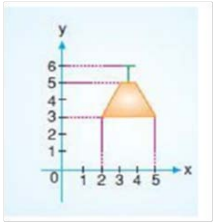
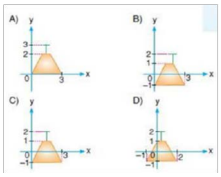
**Elimination of Misconception/Student Difficulty in Lesson Plan and Lecture**

When the strategies used to overcome the misconception/student difficulty are considered, it is seen that 74 strategies are used. Among the strategies used to eliminate misconceptions/student difficulties, it was seen that the most used strategy was asking questions (21.62%), while the other most used strategy was asking mathematical questions (17.56%). The least used strategies are using multiple representations (1.35%) and giving examples from daily life (1.35%). It was determined that only PT6 was used for the strategies of using multiple representations and giving examples from daily life. Considering the strategies used with a focus on eliminating misconceptions/student difficulties in terms of pre-service teachers, the participant reveals a general approach that while PT1 does not use any strategy in this regard, the student should be made aware of the misconception/student difficulty. It was determined that participant PT7, who used the most strategies (31), used 8 different strategies and it was seen that the most used strategy was asking questions, similar to the general result. All of the strategies (40.21%) included in the lesson plan to have group work, give away the misconception and provide cognitive conflict were used to eliminate the misconception/student difficulty during teaching. It was determined that the strategies of solving exercises, telling the truth, using technology and posing problems were not applied during teaching, but were only used in the lesson plan. While it was seen that the most used strategy in lesson plans was making definitions, it was determined that the most used strategy in teaching was asking questions to eliminate misconceptions. The least used strategies are similar in both the lesson plan and the lecture.

**Lecture**

In this section, there are findings about the lectures of teacher candidates. While PT2, PT7, PT8 and PT9 lectures are carried out in accordance with the lesson plans, there are differences in other pre-service teachers.

**Table 5 Conversation between the Teacher Candidate and the Student in Solving the Question**

| Question Asked | Pre-Service Teacher-student dialogue |
|---|---|
|  <br>  <br>Yandaki şeklin koordinat ekseninde x eksenine parallel 2 birim sola ve y eksenine parallel 4 birim aşağıya ötelenmesiyle oluşan şekil aşağıdakilerden hangisidir? | Student: 2 Units to the left …..<br>Teacher: ….. what were we doing when we were shifting left and right?<br>Student: First of all, we will shift according to the x-axis while making right and left. 2 units to the left, so 2 units this way. I subtract 2 out of 5. It's the outermost corner that will come to 3. So in this case A, B, C remain. D is already going. We will go down 4 units according to the Y axis. At 5, the y coordinate will be at 1 when we go down 4 units. Then B and C Remain. Is there any difference between B and C?<br>Teacher: Bottom line …. You just did this (it shows the coordinate value) right now. And take this one. Take that corner too. It's three sided.<br>Student: Sorry. 0 x axis becomes 0 then from 1-1. The y-axis also becomes -1 from 3-4. Isn't it the same then?.... huh ok …. When the green line stays in the middle C then. |

PT5 dealt with the difficulties of not being able to establish a relationship between the quadrilaterals and not accepting the different representations of a quadrilateral, which PT5 identified regarding the lecture topic, by explaining on the slide and asking questions to the students. He did not use the strategy of making activities through the concrete materials specified in the lesson plan.

## Conclusion

When the lesson plans of the pre-service teachers participating in the research are examined, it is seen that some of them adequately express their misconceptions about the subject they will teach in the lesson plans, while some of them express them in general without giving details. Similarly, it is seen that the strategies are general strategies such as associating the subject with daily life, students' asking questions, discovering their mistakes, and embodying the lesson with materials and not subject-specific. The limitation observed in the lesson plans in terms of misconception/student difficulty was also observed in the lectures. This situation highlights the fact that the prepared lesson plan affects the lecture. As Bilen (2002) states, when the lesson plans are prepared in detail, the quality of the teaching will increase. For example, as PT7 emphasized in her lesson plan, it is seen that she is quite rich in terms of the misconception/student difficulties she foresees and the strategies she develops for them. In addition, it is seen that the candidate included question-answer, brainstorming techniques, group work and class discussion in his activities. As Konyalıoğlu, Konyalıoğlu and Işık (2002) stated, the success in the lesson taught using the lesson plan is significantly higher than the success of the group in which lessons are taught without a plan. When the lectures of the pre-service teachers are examined, it is seen that they mostly included the misconception/student difficulties they stated in the interviews and lesson plans before the lecture. However, it is seen that this situation, as in the example of PT8, seems to have been expressed by some pre-service teachers that the fact that they gave a lecture based on misconception/ student difficulty created a situation that would prevent them from dealing with other elements of lecture.

As for the strategies used by the candidates in addressing their misconceptions, they seem to be

many and varied. Among the strategies developed by the pre-service teachers against misconceptions/ student difficulties, it was seen that the most prominent strategy was to show an example on the slide/board, then to put a student to the blackboard and have a solution with the question-answer technique, and in the last stage to explain to the class. It is seen that the pre-service teachers who predominantly adopt these strategies perform their lectures through plain lectures. In addition, there are candidates such as PT2 and PT7, who use group work and classroom discussions to address misconceptions/student difficulties and adopt a more student-centered approach. As a result, it is possible to say that the strategy chosen here affects the teaching methods and techniques.

As it is known, lectures using micro-teaching technique are carried out by pre-service teachers in an artificial environment against their peers and instructors who are deprived of real classroom environment, real students, and who have a good command of the subject they teach. For this reason, the strategy based on example/question solving by putting a student on the board often does not provide the expected benefit (Peker, 2009). For example, as observed in the case of PT8, the fact that the pre-service teacher, who is put on the board in the role of student, does not exhibit the misconception/student difficulty expected by the student, causes situations such as whispering in the ear of the pre-service teacher who is giving the lecture to show her misconception. However, group or class studies based on concept cartoons or well-prepared worksheets are thought to be effective in overcoming such difficulties. As a matter of fact, teacher candidates PT2 and PT7 preferred these strategies, and they were able to effectively reflect misconceptions/student difficulties thanks to these strategies chosen by both pre-service teachers. These preferences have made the lectures of the candidates mostly student-centered and rich in activities for students to discover. The artificiality of such strategies used in microteaching technique, and the unwillingness of pre-service teachers who listen to the lesson to participate in the lesson, etc. It is thought to be a solution to the criticism (Cripwell & Geddes, 1982; He & Yan, 2001; Stanley, 1998).

Although it is not possible to come across a clear definition of how a "good mathematics teaching" should be in the literature, it is possible that there is some evidence from the efforts of some researchers on what a good teaching is and what it looks like (Gallivan, 2014). While there is no definition of the best, research shows that some teaching practices have the potential to increase learning in mathematics. As Gallivan (2014) states, collaborative group work, including math activities that require high-level thinking skills, class discussions, etc. It is possible to say that the lectures of the pre-service teachers who include applications are more qualified in terms of mathematics teaching.

While the common approach used by the pre-service teachers participating in the research in their lectures was to reflect the activities/questions on the slide or to write on the board, very few of them used materials in their lectures. These materials are a material close to the concept cartoon, the thermometer used to model the vertical number line concept, Geogebra, a dynamic mathematics software to be used in teaching the addition of integers with the help of the slider feature, number stamps, equal-arm scales to model the concept of equations, and the area formula of polygons to discover the area formula of polygons. Scissors and squared paper. However, as a result, the majority of these materials are not materials that directly refer to the misconception/ student difficulty, but are related to the lecture, and it coincides with the result that the strategy of addressing the misconception/student difficulties through a sample question by taking students to the blackboard is the dominant strategy.

In line with the results obtained from the research, the following suggestions can be given:

- It is possible to consider the fact that a compulsory course called "Misconceptions in Mathematics Teaching" has been included in the Primary Education Mathematics Teaching Undergraduate Program as of 2018, as a positive step in this direction.
- İt is thought that choosing activities carried out with concept cartoons or well-prepared worksheets will provide a more qualified

learning. Therefore, it is necessary to increase the skills of pre-service teachers in preparing worksheets, concept cartoons, well-organized group work and classroom discussions.

- It is thought that more in-depth investigations on the subject of future research in a real classroom environment will contribute to better observing the knowledge and skills of pre-service teachers and better discussing the results obtained from the current research.

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