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The Awareness of Prospective Mathematics Teachers on the Mathematics Curriculum

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ABSTRACT

This research aims to examine the pre-service mathematics teachers' awareness of the special aims, application principles, and learning areas of the mathematics course curriculum. In this study, which was conducted with 30 primary school mathematics teacher candidates selected by convenience sampling technique, the case study design, one of the qualitative research approaches, was preferred. The data of the research were collected with an opinion form that included three open-ended questions questioning the specific aims, application principles, and learning areas of the mathematics curriculum. Descriptive analysis was used in the analysis of the obtained data. As a result of the research, it was seen that the participant teacher candidates mostly emphasized the items related to the use of mathematics in daily life within the scope of the program's special objectives. It can be said that the candidates mostly care about taking into account the individual differences of students in mathematics teaching, the use of materials, and the principle from concrete to abstract in mathematics education. In addition, it has been determined that all participants have knowledge of the learning areas in the secondary school mathematics curriculum and at which grade levels these learning areas are taught. As a result, it can be said that the awareness of the teacher candidates who will be the implementers of the training programs is high.

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1. Introduction

The curriculum is one of the most critical components of the educational system. The curriculum is adapted according to the demands of the times. Scientific and technological developments increase the importance and necessity of mathematical education (Posluoğlu, 2002). The development of science affects mathematics education, and researchers make corresponding changes in mathematics education (Lichtenfeld, Pekrun, Stupnisky, Reiss, and Murayama, 2012). In this context, mathematics teaching programs have always been affected by scientific, technological, and educational sciences developments, and specific changes have been made in the curriculum (Başak and Saraçoğlu, 2022). In 2005, a radical changing process was initiated for all programs, and the curriculum was redesigned according to the principle that "every person can learn mathematics" (Ministry of National Education (MEB), 2005). In 2013, the curriculum was updated again. Finally, in 2017, the change started with the new draft program. The program has been presented to the experts' opinion. It remained in practice for one year, and regulations were made on it. In 2018, updated the program. In 2018, in the program application, "21st factors such as "century skills," and "basic skills" have been characterized in the program (Ministry of National Education (MEB, 2018). The new program based on a constructivist

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approach has changed the roles of math teachers. In this approach, the teacher does not just pass on the information and manage the classroom. Instead, the teacher is in the role of leading the students. Accordingly, teachers expect to adopt the constructivist approach to the new curriculum. In this way, a teacher better motivates his students, respects them, allows them to express themselves, and sets the lesson's goals with them (Süral, 2013). It also changes the roles imposed on the teacher and the student (MEB, 2018). Attempting to convey extensive knowledge in a given period may result in students being unable to make connections between information (Bransford et al., 2000). In addition, how much, how, and why the curriculum is presented and what topics it contains sheds light on the curriculum's implementation and the student's development. When the program is implemented, it is necessary to obtain information about the program to adapt to the needs, changes, and innovations and to move forward in the field of program development (Demirel, 2015). The curriculum should first inform, change and mobilize teachers. The success of a training program depends primarily on whether it is understood and accepted by the people who are supposed to implement it, namely the teachers (Sezgin-Memnun, 2013). If the program is not effective among teachers, it cannot be said to have an impact on students (Bruner, 1977). At this stage, the opinions of the teachers who implement the program are critical. Positive and negative aspects of the program can be evaluated based on the teachers' opinions.

In the field studies on mathematics education curriculum, mathematics education at the primary level according to the beginning program (Albayrak and Çiltaş, 2017; Aslan and Olkun, 2011; Baş, 2017), according to the opinions of teachers or administrators (Dağdelen and Ünal, 2017; Öksüz, 2015; Özdemir). In addition, the studies mainly deal with the views of teachers and students on the implementation, elements, design, or evaluation of the curriculum (Ulusoy, 2012; Ünal, 2018; Konur andAtlıhan, 2016; Cansız Aktaş, 2008; Abdioğlu and Çevik, 2018). In national studies, some studies evaluate the mathematics education program from different perspectives (İncikabı et al., 2016; Güzel and Şahin, 2019), as well as studies that compare it with previous programs (Sezgin-Memnun, 2013) and with the programs of different countries (Guzel et al., 2013); Erbilgin, 2014; Öztürk and Özmantar, 2016). In the studies conducted with preservice teachers (Erdem and Eğmir, 2018; Çetinkaya and Tabak, 2019), the level of knowledge of teacher candidates about the education program was determined and analyzed according to variables (such as gender, age, department, type of education, and academic achievement). In examining academic studies in this area, it is noticeable that few studies examine teacher candidates' awareness of the program. However, understanding the curriculum, which is a guide for teachers, and obtaining information about the adopted curriculum understanding, purpose, content, teaching methods and techniques, measurement and assessment, and learning areas that have changed over the years is essential for preparing preservice teachers for the profession (Çetinkaya and Tabak, 2019). In this context, prospective mathematics teachers need to be informed about the standards set in the curriculum and the professional competencies expected of them. During their university education, teacher candidates receive information about the contents of the curriculum in various courses. However, it still needs to be determined to what extent they know the importance of the tasks imposed on teachers by the programs. With this in mind, this study aims to investigate prospective mathematics teachers' awareness of the mathematics education curriculum's specific objectives, application principles, and learning areas. According to the established objective, "What is the prospective mathematics teachers' awareness of the specific objectives, application principles, and learning areas of the mathematics education curriculum?" Within the main research question of the form, the study sought answers to the following sub-questions.

1) What do preservice mathematics teachers know about the special aims of the mathematics education curriculum?

2) What is preservice teachers' awareness of the applicable principles of mathematics education?

3) What is preservice teachers' awareness of the learning areas of the mathematics curriculum?

2. Method

Case study design, one of the qualitative research approaches, was preferred in this study. A case study is a qualitative research method in which the current phenomenon is studied in depth in its natural setting (McMillian, 2000; Yin, 2003). The data was collected with a measurement tool containing open-ended questions, and the collected data were analyzed to reveal descriptive findings and results regarding the situation examined. As it is known, such studies are carried out not for the purpose of generalizing the data obtained, but for the purpose of evaluating a phenomenon with its unique characteristics (Yıldırım and Şimşek, 2005). The purpose of this study is not to make generalizations, but to evaluate the selected case. For this reason, the research design was chosen as a case study. In addition, the study was designed according to the holistic single case design type, which focuses on a single unit of analysis, one of the case studies types (Yin, 2009). The fact that the situation was examining the awareness of prospective teachers about the Mathematics Curriculum enabled focusing on a single unit of analysis.

2.1 Participants

The study participants consisted of 30 volunteer preservice teachers in the 4th year of the elementary school teacher education program at a state university. They were randomly selected. Twenty-four of the participants were female, and six were male. The prospective teachers have taken many significant courses and have pedagogical knowledge related to mathematics education. Therefore, preservice teachers are assumed to have some knowledge of the curriculum, application principles, and mathematics learning areas. For data confidentiality reasons, participants were coded as P1, …, P30.

2.2 Data collection instrument

The intended change in mathematics instruction and student attitudes toward the mathematics curriculum be indicated in 13 items (Appendix 1) in the section " Specific Objectives of the Mathematics Curriculum" (Ministry of Education [ME], 2018). The program also stated that teachers have flexibility in determining the instructional approach and the design of the learning environment. In this regard, 13 suggestions (Appendix 2) are titled "Principles Regarding the Implementation of the Mathematics Course Curriculum." The curriculum for mathematics in secondary education includes five learning areas: Numbers and Operations, Algebra, Geometry and Measurement, Data Processing, and Probability. These five learning areas that make up middle school mathematics education form the basis of today's mathematics curriculum (Huntly, Rasmussen, Villarubi and Sangtong, 2000). Some grade levels include all learning areas. Some are not. For example, the algebra learning area is included in all grades except 5th grade, while the probability learning area is included only in 8th grade.

On the other hand, the numbers and operations, geometry and measurement, and data processing learning areas are present in all grades (TTKB, 2013). In this regard, three questions were prepared for the data collection instrument by consulting the relevant literature and expert opinions to investigate prospective mathematics teachers' awareness of the specific objectives, application principles, and learning areas of the mathematics education curriculum. The prepared questions are appropriate for measurement, and whether they represent the field is determined based on "expert opinion" (Karasar, 40, 1995). For this reason, two expert mathematics educators discussed the question of the purpose of measurement and the content analysis required for these purposes. In addition, it was discussed whether the questions represented these goals and content and whether necessary corrections were made. The opinion questionnaire questions created as part of the study are listed below.

1- In your opinion, what are the three most critical specific goals of the mathematics curriculum? Explain with a rationale.

2- Explain and justify what you think are the three most important principles that should be considered when implementing the mathematics curriculum (mathematics education).

3- How many learning areas are included in the secondary mathematics curriculum? Briefly introduce each learning area and indicate which grade levels (5, 6, 7, 8) are taught data collection

The data was collected during the sixth week of the " Developing Activity in Mathematics Teaching" course taught in the undergraduate program as a course for 4th graders. In the previous weeks, the specific goals of the mathematics curriculum were discussed with the participants theoretically. In addition, information was provided on the principles of application of the mathematics curriculum. Furthermore, a discussion of the learning areas was held with the preservice teacher. At which grade level these learning areas are included in the program was examined in detail. In addition, the preservice teachers took a secondary school mathematics programs course in the second semester of the second year of study.

Thirty candidates voluntarily participated in the study. As part of the study, an opinion sheet with three open-ended questions was distributed to the participants. The teacher candidates answered the research questions in writing under the researcher's supervision for 40 minutes. The data were obtained in a classroom where individuals had little interaction. All participants answered the questions individually.

The researcher tabulated the responses by examining the data over one month. In addition, after reviewing the answers, the participant was asked to explain his answer if the solution approach needed to be clarified. This way, all written statements became clear and understandable to the researcher.

2.3 Analysis of Data

This study used written data and statements in the opinion forms of preservice teachers as data sources. Descriptive analysis was used in the analysis of the data obtained. First, each participant was numbered and coded as (P1, P2, ..., P30). The specific objectives of the curriculum (SM1, SM2, …, SM13) and the application principles of the curriculum (IP1, IP2, …, IP13) were also coded. The answers of the preservice teachers were classified according to these codings. The data obtained were tabulated by calculating the frequencies and percentages of the responses. The data were analyzed separately by two mathematics educators. According to Catalano and Creswell (2013), it is essential to have multiple coders code the transcribed data and establish consensus among the coders to ensure reliability. The percentage of consensus between coders was calculated as 91% according to the formula of Miles and Huberman (1994). This situation is sufficient for intercoder reliability. Finally, inferences from participant statements and interviews were used to validate and support the data. The diversity of data provided in this manner contributed to validity and reliability. In this study, while preservice teachers shared the specific goals of the curriculum, their approaches to arranging those goals and the reasons they gave for doing so were related. They were asked to explain why they attach importance to the curriculum's application principles, so participants' responses were examined in depth.

3. Findings

This section reports the results of prospective teachers' responses to the questions.

The result of the analysis of the answers given to the first question, "What are the mathematics curriculum's three most important special aims? Explain with reasons." is presented in Table 1. In Table 1, the specific objectives of the curriculum regarding mathematics education are given abbreviated as SM1,…, SM1, respectively.

Table 1. Findings on awareness for special aims

Specific Objectives	SM1	SM2	SM3	SM4	SM5	SM6	SM7	SM8	SM9	SM10	SM11	SM12	SM13
Frequency	22	15	8	4	1	7	7	0	1	7	6	5	3
Percentage	73.3%	50%	26%	13%	3,3%	23%	23%	0%	3%	23%	20%	16%	10%

Table 1 showed the distribution of the curriculum's mathematics-special aims according to the top three rankings. At the beginning of the special aims, preservice teachers focused on important: "Students will be able to develop and effectively use their mathematical skills." The first item (73.35%) was as follows. The second item was "The student will be able to understand mathematical concepts and apply those

concepts in daily life." Finally, there is a second item (50%). It was found that these two items were included in the responses of all teacher candidates. On the other hand, "The student will be able to express the concepts with different forms of representation." The eighth item in the form is not in the ranking of any pre-service teacher. "The student can grasp the relationships between people and objects and the relationships of objects to each other using the meaning and language of mathematics." and "The student develops a confident approach to mathematical problems by developing a positive attitude toward mathematics through their experiences learning mathematics." One pre-service teacher only mentioned the fifth and ninth items on the form. Some examples of student responses are listed below.

P19: "SM1 comes first because the ability to read and write mathematically is essential to mathematics or mathematical problems, concepts, operations, and formulas. To understand and use the language of mathematics well and correctly, one must have acquired mathematical literacy."

P2: "SM1 comes third because mathematical competence means having high thinking skills such as critical thinking, creative thinking, logical thinking, and reflective thinking. In other words, mathematical literacy means more than just being able to perform arithmetic operations. In addition to arithmetic, students with mathematical literacy can also think critically and creatively.

P17: "SM2 occurs in the first because misunderstandings can be avoided by making mathematical concepts understandable. Relating the concepts learned to daily life and applying them makes learning more permanent."

P22: "SM3 comes first for me because problem-solving and understanding problems are applied in mathematics and daily life. It gives individuals multi-dimensional thinking skills and develops different perspectives."

P5: "SM9 can rank second for me because a positive attitude noticeably increases students' mathematical achievement."

P12: "SM6 ranks first for me because metacognitive skills can be used to train oneself, and stability in one's learning can make learning continuous and systematic. This leads to success in mathematics."

From the answers given above, it can be seen that the students gave their priorities along with their reasons. This can be seen as a clue that they have internalized the specific objectives of the program.

The summary of the analysis of the answers to the second question "Explain and justify what you think are the three most important principles that should be considered when implementing (teaching) the mathematics curriculum." is presented in Table 2. In Table 2, the principles to be considered in the implementation of the Mathematics Curriculum (in teaching mathematics) are given abbreviated as IP1,…, IP13, respectively.

Table 2. Findings on Awareness of Implementation Fundamentals

Implementations	IP1	IP2	IP3	IP4	IP5	IP6	IP7	IP8	IP9	IP10	IP11	IP12	IP13
Frequency	20	13	15	5	1	7	8	19	0	3	1	2	2
Percentage	66%	43%	50%	16%	3.3%	23%	26%	63%	0%	10%	3.3%	6.6%	6.6%

Table 2 showed the distribution of principles to be considered in the implementation (of mathematics teaching). The beginning of the principles that the prospective teachers focused on is "The individual differences of the students should not be neglected. For this reason, applications emphasizing students' learning styles and strategies should be given priority and importance in teaching mathematics," according to IP1 (66%). Second, "The individual and cultural differences among students should be considered when implementing the program. In this context, appropriate methods and approaches for teaching mathematics should be a priority," according to IP8 (63%). Number cards, tens blocks, fractions, etc., ranked third and are used as often as possible when teaching new concepts and assessments. IP3 (50%) recommended using concrete materials such as blocks of ten. On the other hand,

no students mentioned IP9, and only one prospective teacher mentioned application principles such as IP5 and IP11 in the top three in order of importance. Below are some examples of student responses.

P14: "I think IP1 is the most critical issue because every student is always learning speed differently. Implementing a curriculum aimed at meaningful learning should consider that every student is unique and cannot learn at the same level and at the same time.

P3: "Pay attention to individual differences (IP1) because not every student is at the same level and can learn in the same way. For example, some students are visual; others are emotional..."

P5: "Identifying the prior information (IP2) is the first to consider when using the program because if the prior information is not identified, it will be difficult to understand the new subject because of the deficits in the old subject."

P15: "Students' prior knowledge should be identified (IP2) because when we teach a subject, we pay attention to students' prior knowledge if it is related to the subject they learned before. If he doesn't remember the subject he learned first, we summarize it and then start the new subject."

P7: "For me, the recommendation to use concrete materials (IP3) in class is second because most of the concepts covered in math class are abstract, and using materials that the student can interact with during class both grabs the student's attention and facilitates learning."

P24: "IP7 is important to me because by considering that mathematics is a part of our life, students' attention should be drawn to the lesson with examples from daily life."

P5: "I think IP5 should come first because the teacher should take a guiding role to build students' confidence and desire to solve problems."

As can be seen from the student answers above, students give their priorities along with their reasons. This can be seen as a clue that they have internalized the application principles of the program.

The analysis results of the responses to the third question in summary form "How many different learning areas are included in the secondary math curriculum? Briefly introduce each learning area and indicate which grade levels (5, 6, 7, 8) are taught." are summarized in Table 3.

Table 3. Results on awareness of learning areas

Learning Area	5th Grade		6th Grade		7th Grade		8th Grade		Total	
	n	%	n	%	n	%	n	%	n	%
Algebra	30	100	30	100	30	100	30	100	120	100
Geometry	28	93	30	100	28	93	28	93	114	95
Measurement	28	93	27	90	30	100	30	100	115	96
Number and Operations	29	96	30	100	26	86	28	93	113	94
Probability	30	100	30	100	26	86	28	93	114	95

Table 3 showed the level of knowledge of the preservice teachers about the learning areas. All the participants were able to fully define the learning areas of "Numbers and Operations," "Algebra," "Geometry and Measurement", "Data Processing," and "Probability" in the secondary school curriculum. All preservice teachers knew that the learning area "Algebra" is included in all grades except 5th grade. Although 95% of preservice teachers knew that the learning area "Probability" is included only in 8th grade, the percentage of those who did not know that the learning areas "Numbers and Operations," "Geometry and Measurement," and "Data Processing" was present in all grades ranges from 4% to 6%. Therefore the students have sufficient knowledge about their learning areas.

P11: "In the secondary school curriculum, there are five learning areas: "Numbers and Operations," "Algebra," "Geometry and Measurement," "Data Processing," and "Probability." "Algebra" is available from grade 6, but "Probability" is in the curriculum until grade 8.

P29: "Learning areas at the secondary level are "Geometry and Measurement," "Data Processing," "Numbers and Operations," "Algebra," and "Probability." Probability is taught only in grade 8, and "Numbers and Operations" and "Geometry and Measurement" are taught in all grades."

As can be seen, students gave detailed answers to this question. Based on this, it can be said that teacher candidates' level of knowledge about learning areas is good.

4. Discussion and Conclusion

The study examined preservice teachers' awareness of the mathematics curriculum in three ways. First, the preservice teachers answered to list the particular aims and application principles that they considered crucial among the aims and application principles of the mathematics curriculum. In addition, they briefly introduced the areas based on grade level for the preservice teachers' awareness of learning areas. In this way, the 30 preservice teachers' priorities and awareness of the mathematics curriculum were determined through numerical data.

When the order of importance given by prospective teachers to the specific objectives of the mathematics curriculum is examined, it is seen that "The student will be able to develop mathematical literacy skills and use them effectively." and "The student will be able to understand mathematical concepts and use these concepts in daily life" appear to come to the fore. It was observed that these two items were included in the rankings made by all prospective teachers. First, Galileo's "Mathematics is the language of the great book of nature." As he means to say by his word, mathematics takes place in every aspect of our lives. Accordingly, we must understand mathematics to the best of our ability and shape our lives by developing mathematical skills. Second, Lutzer's (2005) study found that when students express mathematical equations, they try to solve problems mechanically without understanding their thoughts. Mathematics teachers play a significant role in closing this gap. In this regard, the preservice teachers at these two points can be considered positive. In parallel, it can be stated in this study that there is a prevalent expectation that teacher candidates will give more space to mathematical problems of daily life in the future when practicing their teaching profession. In Budak and Okur's (2012) study, it was found that teachers needed help to fully grasp the philosophy and objectives of the mathematics curriculum for curriculum. In contrast, in this study, the prospective teachers understood the program's objectives.

According to the results of the prospective teachers regarding the principles of application of the mathematics curriculum, the first two items are IP1 and IP8, which recommend taking into account the individual differences of the students and, in this context, choosing appropriate methods and approaches for teaching mathematics. Number cards, tens blocks, and fractions come in third place, used as often as possible when teaching new concepts and assessments. IP3 recommends using concrete materials such as According to the research results, preservice teachers pay attention to the individual differences of students in mathematics teaching, the use of materials, and the principle from concrete to abstract in mathematics teaching. Curriculum materials strongly influence the instructional practices of beginning teachers at the beginning of their careers (Grossman and Thompson, 2008). As a result, the quality of mathematics instruction taught with curriculum materials is increasing (Gündüz and Odabaşı, 2004). The materials, teaching methods, and practices that the teacher uses shape students' experiences with the educational program (Ornstein and Hunkins, 2017). The fact that prospective teachers recognize the importance of teaching mathematics in this way provides hope for the future of education. For this reason, preservice teachers prioritizing these issues is seen as a positive outcome in their approach to mathematics education.

Almost all of the preservice teachers know exactly the learning areas of "Numbers and Operations," "Algebra," "Geometry and Measurement," and "Data Processing and Probability" in the mathematics curriculum and in which class these learning areas are located. Therefore, the content of the programs is directly related to the quality of education (Bal and Artut, 2013). In this regard, practitioners must organize, plan, and systematically adopt curricula (Malhotra, 2006). In this regard, from the analysis of

the responses that the awareness of the preservice teacher who will implement the training programs is high.

Teacher candidates' perceptions and awareness of the curriculum they are responsible for will undoubtedly affect their future learning and teaching perceptions. Future research can examine the items that preservice teachers attach importance to in the curriculum at different points in time as a function of different variables (such as gender, academic achievement, and age). Similarly, the same questions can be asked of preservice teachers when they begin to pursue a word profession, and the change in outcomes can be examined. Thus, changes in ideas in practice are detected. Teachers have a central role in developing and implementing education programs (Zeybek and Karataş, 2022). For this reason, studies with teachers about the educational program can guide teachers to provide appropriate support. The continuity of studies related to this educational program is essential for continuous knowledge and meaning construction.

5. Author Contribution Rates

The authors took an equal part in all processes of the article. The authors have read and approved the final version of the study.

6. Ethics Committee Statement

This study was carried out with the approved decision of the Kastamonu University Social and Human Sciences Research and Publication Ethics Committee (Protocol No. 2022/35) at the 2022/6 meeting dated 9.06.2022.

7. Conflict of Statement

The authors declare that there is no conflict of interest with any institution or person within the scope of the study.

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