

Investigation of Pre-service Mathematics Teachers' Opinions on Using Map in Teaching Mathematics¹

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SUMMARY

This research aimed to collect the experiences and opinions of pre-service mathematics teachers on the use of maps in mathematics teaching. The case study design, a qualitative research design, was used in the research. Eight volunteer pre-service teachers attending the primary school mathematics teaching program of a state university in the spring term of the 2019-2020 academic year, participated in the research. This study group was determined by the purposive sampling method, a non-random sampling method. The data of the research were obtained from the pre- and post-interview forms, the task forms, and the lesson plans prepared by the participants. In the research, the pre-interview form created to see the pre-service teachers' thoughts about the use of maps in mathematics teaching and their preliminary knowledge about maps, was applied to them at the beginning. Afterwards, the pre-service teachers were given a lesson plan template suitable for the 5E model and were asked to create a lesson plan by using map. After the pre-service teachers' experience in preparing lesson plans using maps, the post-interview form was applied to them at the end of the application. As a result, it was seen that the pre-service teachers had no experience with the use of maps in mathematics teaching, and after their lesson plan preparation and application experiences, the majority of them stated that map can be used as a learning tool in mathematics education. Based on the findings, we recommend that mathematics teachers should use maps as a tool in mathematics teaching.

Keywords: Mathematics education, pre-service mathematics teachers, usage of map in mathematics teaching, map literacy

INTRODUCTION

Throughout history, the definition of reading and writing has changed in line with the developments in science and technology and the changing needs of societies. Reading and writing simply means that the individual can decode the symbols they see and write what they see. In addition to reading comprehension, literacy can be expressed as knowledge generation, critical thinking, and reasoning based on knowledge (Çiltaş, 2020). Literacy, which has undergone a conceptual change, has become a skill today (Gençtürk & Karatekin, 2013). Knowledge of science literacy, media literacy, technology literacy, map literacy, mathematical literacy, and a wide variety of literacy areas specific to each field are of great importance in sustaining an individual's life (Cendek, 2015).

Mathematics is an important discipline that we encounter in all areas of our lives and to which we turn to. During the historical development of human beings, mathematics has existed and has been integrated with life over time. Issues such as problem solving, geometric shapes, arithmetic operations that are integrated with mathematics are very important in the past and today. However, today's changing world standards have led to some innovations in mathematics. Measurement skills and numerical skills, which are the basis of mathematics today, are no longer sufficient for individuals to participate in society. With the rapidly changing knowledge and technology, the need for individuals who have the ability to think and produce has increased the importance of teaching mathematics (Erdoğan, 2018). One of the aims of teaching mathematics is to train individuals who develop mathematical literacy skills and can use this skill effectively (Ministry of National Education- [MoNE], 2018, p.9). With the developing technology, the place of mathematics in daily life has gained importance. As a result of these developments, the responsibilities of individuals in modern society make mathematical literacy important (Höfer & Beckmann, 2009). It is understood from here; Mathematical literacy is as important as being native literate for individuals to take an effective role in society (National Council of Teachers of Mathematics - [NCTM], 1989; Ojose, 2011).

Today, mathematical literacy has become an important part of daily life as a result of the increasing importance given to the speed of production and use of information. In recent years, mathematical literacy has become the main goal in modern mathematics education (Höfer & Beckmann, 2009). Although there are various definitions

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of mathematical literacy in the literature, the common opinion is that it is a very valuable skill that enables an individual to use mathematics in daily life (Höfer & Beckmann, 2009; Jablonka, 2003; Kaiser & Willander, 2005; Ojose, 2011). Mathematical literacy enables an individual to understand the role of mathematics in life, to base his / her judgments on solid foundations, and to use mathematics enough to meet his / her own needs (MoNE, 2011). In other words, mathematical literacy is expressed as an individuals' use of their mathematical knowledge and skills to solve problems encountered in daily life (Kabael, 2019).

The concept of mathematical literacy is largely equivalent to the concept of mathematical thinking (Kilpatrick, 2001). Emphasizing the need to focus on the social role of mathematics rather than the needs of mathematics, which is a scientific discipline, Keitel, Jablonka and Gellert (2013) seem to emphasize the needs of individuals in the definition of mathematical literacy (Bozkurt, 2019). Mathematical literacy is the ability of individuals to use mathematical knowledge and understanding effectively to solve problems they encounter in daily life (Sari & Wijaya, 2017). Mathematical literacy is defined as the capacity of the individual to use, formulate and interpret mathematics in the Organization for Economic Co-operation and Development (OECD) sources (1999; 2003; 2006; 2009; 2013). Also in the literature, it is defined as the capacity to understand the role of mathematics and to use mathematics effectively in solving problems (McCrone & Dossey, 2007; Steen, Turner, & Burkhardt, 2007).

Although it is known that the concept of mathematical literacy emerged with the Program for International Student Assessment (PISA) implemented by the OECD, this concept was seen as a goal in mathematics education, mostly with the transition of the world from the industrial society to the information society at the end of the 19th century (Yenilmez and Ata, 2013). The National Council of Mathematics Teachers (NCTM, 1989) states that mathematics literacy is important for individuals to think, understand and interpret mathematics in solving problems they encounter in daily life. Mathematical literacy, in its broadest sense, includes knowledge of mathematics, and it is the need to use the skills of individuals to solve problems that require numerical reasoning, which they encounter in daily life, with an emphasis on thinking, reasoning and interpretation (De Lange, 2003). In this context, it has a very comprehensive definition because it requires mathematical literacy, the use of mathematical tools and mathematical reasoning in terms of its use in daily life. Mathematical literacy has a guiding feature in the lives of individuals and explains in a broad framework where and how to use an important tool such as mathematics in the face of problems that individuals may encounter in gaining a place in society (Konukoğlu, 2019).

Educators combine reading, writing, listening, speaking and critical thinking skills with education in order to develop mathematical literacy skills, which are needed in daily life and business life and have a key role in coping with the changing social order (Bozkurt, 2019). According to Ojose (2011), mathematical literacy requires having the necessary authority and a sense of trust to apply the information learned during this process in real life, as well as mastering the application steps to be followed in the education and training process. According to Colwell and Enderson (2016), a mathematical literate individual should have high-level thinking skills such as mathematical reasoning, analytical thinking and interpretation, communicating with mathematical concepts in real life situations, understanding and applying mathematics. Individuals who can read, analyze, and form information by writing mathematical texts such as numbers, symbols and graphics can be considered as mathematical literate (Colwell & Enderson, 2016; Siebert & Draper, 2008).

In PISA reports, Turkey's situation was dealt with in the context of mathematical literacy and it was emphasized that the processes followed in education system should be revised (Bekdemir & Duran, 2012). According to Bozkurt (2019), it is important for today's information society that a mathematical literate individual has sufficient knowledge in the field of mathematics, which is in relation to real life. According to Ersoy (2003), all individuals in the society should have mathematical literacy skills and programs should be prepared accordingly. Özgen and Bindak (2008) underline that teachers should have these skills in order to gain mathematical literacy skills to individuals. In this context, in order to raise individuals with mathematical literacy skills, mathematics teachers' attitudes and approaches towards mathematics play a decisive role; therefore, it is important for pre-service teachers to know the concept and content of mathematics literacy in line with the changes and regulations made in the curriculum (Şefik & Dost, 2016).

Although mathematics is considered as a discipline independent from other courses, knowledge and skills gained by Turkish, science, social studies and even visual arts are usually needed in mathematics teaching (Özaydınlı Tanrıverdi & Kılıç, 2019). Especially in social studies course, many knowledge and skills gained by mathematics; the knowledge and skills gained by social studies course are also needed in mathematics lessons (Pala & Başbüyük, 2019). So much so that, in the Social Studies Curriculum (2018), the basic skills aimed to teach students are map literacy, using evidence, location analysis, spatial perception, problem solving, drawing and interpreting tables, graphics and diagrams, and a certain level of mathematical knowledge and skills requires.

Ünlü, Üçışık, and Özey (2002) describes the map as an example of a bird's-eye view of the earth or a part of it drawn by mathematical methods, scaled down to the desired scale, with special signs on a plane. In order for a map, which is frequently encountered in daily life, to be read, understood and used by individuals, it is necessary to acquire and develop map reading skills in education process (Tarman, 2017). Maps that future generations will

need more than ever to travel to unknown places have a vital value in bringing other parts of the world to our current habitat (Gengler, 1974). As a matter of fact, it has become important to be a map literate in today's technology, also in electronic environments. Today, thanks to the availability of smart boards and computers in many schools, it has become much easier for teachers to include the use of maps, a visual and digital material, in their lessons.

Map literacy is the name given to the reading and understanding of the colors, signs, symbols and map legends on a map and the skills of interpreting, analyzing and evaluating on a map (Cendek, 2015). Among the eight different types of intelligence explained by Gardner (2013), there is also a relationship between visual, logical, verbal intelligence types and map literacy. In this context, it is thought that conducting activities related to logical, verbal, visual intelligence fields on maps in order to improve map literacy in students may be beneficial in the development of students' map literacy skills. By gaining map literacy, it is ensured that individuals become more successful in their academic and social lives. Individuals with map literacy skills can more easily solve the problems they encounter in their daily lives (Taş, 2008). At the same time, map literacy contributes to the effective use of technology by individuals with the emergence of maps on phones, computers and everywhere thanks to technology (Sönmez & Aksoy, 2012).

Map is a teaching material that can be used by individuals in solving some problems they encounter in their daily life and in learning the necessary information for life (Cendek, 2015). In addition, map is extremely important as a teaching tool to show the distribution of the situation, phenomenon and characteristics (Pala & Başıbüyük, 2020). They should be able to explain the meanings of the signs on a map, provide the necessary information to interpret and analyze the information, and be equipped to give this information to the students. Therefore, teachers' use of the map correctly and effectively makes understanding a subject taught on the map effective and permanent. At this point, it is important for mathematics teachers to have the necessary knowledge and experience on map literacy in order to be able to use in their lessons.

Our education system aims to raise individuals who are open to innovations, can present different ideas, are creative, have reasoning skills, can establish relationships between different situations and produce solutions. At this point, adopting an interdisciplinary teaching approach that focuses on technological developments is indispensable to achieve the targeted education quality (Özaydınlı Tanrıverdi & Kılıç, 2019). Interdisciplinary teaching approach, which is an important part of the modern education system, is a teaching approach that increases students' will, develops creative and critical thinking skills by taking into account the knowledge and skills acquired by different disciplines, and contributes to their growth as qualified individuals needed by the society (Pala, 2011). The effect of the interdisciplinary approach that connects different courses to each other is also seen in the curriculum. It is seen that the Current Mathematics Curriculum (2018) was created as an integrated curriculum that provides meaningful and permanent learning, and is associated with previous learning and other disciplines, taking into account the interdisciplinary approach.

Discovering the map as a visual depiction tool in displaying the facts and characteristics of a place has established a strong and important interdisciplinary connection (Aksoy, Kılıçoğlu, & Ablak, 2015). At this point, it is thought that it is of great importance to understand the maps adequately. Because map is a visual element that contains many numerical data. In order to better understand a subject that is handled with the use of maps, it is necessary to better grasp the numerical data included in this element, which is possible with the individuals having mathematical knowledge and skills. For this reason, it is very important that mathematics and social studies-geography teachers cooperate. Bednarz and Bednarz (1995) stated that most of the geography teachers nowadays cooperate with other disciplines and argued that the studies of geography teachers, especially with mathematics teachers, will contribute to students' being numerically literate (cited in Tarman, 2017, p.34). Compared to the mathematical knowledge and skills used in some subjects of the social studies course; it is seen that in the Mathematics Curriculum (2018), no objective or explanation about map, which is used as an important material in the social studies course, is mentioned. As a matter of fact, the use of map is a teaching material that requires mathematical knowledge and skills in terms of reading and understanding. Also, it is predicted that using map will be beneficial in terms of the development of mathematical literacy. As it can be understood from the objective of "When drawing a map, it is mentioned that a reduction is made at certain rates" in the Social Studies Curriculum (2018), scaling maps and performing various calculations requires a mathematical skill. For this reason, it is recommended that map as a learning tool in mathematics lessons can be used for more permanent and meaningful teaching of length and area measurements and the development of estimation skills.

Education programs should be a guide for students in keeping up with today's rapidly changing world that we hardly follow (Yılmaz & Ev Çimen, 2020). The emphasis on the interdisciplinary relationship in the curriculum and field research shows its effect with the widespread inclusion of mathematical knowledge and skills in the social studies curriculum. On the other hand, there are insufficiencies in the curriculum regarding the association of mathematics lesson with social studies lesson. When the attainment objectives and explanations in the Mathematics Curriculum (2018) are examined, it is seen that the mathematics lesson is up-to-date, competent and has qualities that can be associated with real life in the learning process. In teaching a discipline with this quality

texture, it is predicted that the use of the map, which presents the world we live in by reducing it with certain scales, is important in terms of establishing a relationship between mathematics and real life. It is thought that map, which provide the opportunity to check the predictions made about location, length and area with real life measurements, can be an important learning tool in mathematics teaching.

Map literacy, which is a standard subject of secondary school social studies course, is thought to be related to mathematical literacy because of the numerical information it contains. Map teaching is divided into two branches as use (literacy) and production. When it comes to teaching the use of maps, this is given in social studies / geography lessons where mathematics knowledge will be sufficient at the secondary education level, while when it comes to map production, it is the subject of numerical fields that require mathematics knowledge at higher education level such as map engineering, geographic information systems, geophysics, defense industry, cadastral activities. While the use of maps requires a practical map literacy that almost every adult will need in daily life without need for expertise, such as the use of navigation devices, location-direction finding, etc.; while map production is a numerical-heavy discipline that requires expertise in science. Both facts support the rationale for teaching basic knowledge of map in primary and secondary education.

For the reason stated above, it is thought that map literacy should be used effectively in mathematics lessons. In this context future mathematics teachers should include the use of map in mathematics teaching and thus contribute to the development of students' mathematical literacy skills. In addition, it is important for teachers to prefer current teaching methods in order to increase the quality of education. It is considered important to apply the 5E model, which is based on the constructivist learning approach in accordance with the requirements of the modern education system and has been widely used in recent years. For this reason, it is important to train pre-service teachers attending education faculties with experience and competence in this subject before the service.

As a result of the literature review, it was seen that there are limited number of studies on the relationship between map literacy and mathematical literacy and the use of map in mathematics teaching. Also, it is important for pre-service teachers to have the competence to prepare lesson plans in accordance with the 5E model. Accordingly, in this research, we aimed to examine the experiences and opinions of pre-service teachers about the use of map in teaching mathematics. The interdisciplinary nature of the research gives it a special importance.

METHOD

In this research, the case study design which is one of the qualitative research designs, was used. Case study is a method in which one or more situations, environments, social groups or other interconnected systems are examined in depth (McMillan, 2000). The focus is on the group (Çepni, 2018). In studies, case studies are used to define and see the details that make up an event, to develop possible explanations about an event, and to evaluate an event (Gall, Borg, & Gall, 1996). For this reason, the case study design was chosen, considering it to be the most suitable method for this research. The main purpose of the case study is to understand a situation as it is and to make detailed descriptions about that situation (Büyüköztürk, et al., 2018). In addition, a case study can present a slice of life directly to the reader, provides in-depth information about a certain part of life and provides an in-depth examination of extraordinary situations (Gall, et al., 1996). For this reason, the multiple case study design, which is considered to be the most appropriate method for this research, was preferred. A multiple case study is to deal with each situation in itself with a holistic approach and then compare these situations with each other (Yıldırım & Şimşek, 2016).

Study Group

In the research, a total of 8 teacher candidates, 7 female and 1 male, who were studying in a primary school mathematics teaching program at a state university in the spring semester of the 2019-2020 academic year, were studied. The research group of the research was determined by purposeful sampling method, which is one of the non-random sampling methods. The purposeful sampling method provides the researcher with the opportunity to conduct an in-depth examination of information-rich situations and to explore and explain the relationships between these situations in line with the purpose of the research (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz, & Demirel, 2018). In determining the participants by purposeful sampling method, the principle of volunteerism was taken into consideration. Participants were informed about the purpose and process of the research by the researchers before the applications. After the information, the permissions of the participants were obtained with the permission certificate. In the research, the real names of the participants were kept secret and the female pre-service teachers were given the code names as "Aslı, Berna, Ceren, Damla, Işıl, Rüya, and Sena" and the male pre-service teacher as "Fatih".

Data Collection Tools

The research data was obtained from pre and post interviews, task forms and lesson plans prepared by the pre-service teachers. In the research, a pre-interview form was prepared in order to see the pre-service teachers' thoughts about the use of map in mathematics teaching and their preliminary knowledge about map and applied to the pre-service teachers at the beginning of the research process. This form was sent to the pre-service teachers

and the opinions of each pre-service teacher were taken in writing. The content of the form includes the use of map as a tool in mathematics teaching, the positive and negative effects of the use of map on mathematics teaching, the contribution of the use of map to the development of students' mathematical skills and competencies. In addition, questions about whether pre-service teachers have experience in using map in mathematics lessons were also included.

In the research, a task form was prepared and applied to the pre-service teachers to examine the curriculum and textbooks in order to have an idea about the use of map as a learning tool in mathematics lessons before the experience of preparing a lesson plan. The content of the form includes the questions asked to the pre-service teachers to have an idea about map and mathematical literacy and to increase the quality of the lesson plans they will prepare, which subjects / attainment objectives about map are included in the curriculum, and what are the activities and visuals in the textbook. In addition, in the form, pre-service teachers were asked for which subject / attainment objectives they would use map as a learning tool in mathematics lessons. The purpose of giving this task form to re-service teachers is to make them aware of the curriculum and the textbook before they experience preparing a lesson plan using a map, and to give a preview on which subjects and concepts the map can be used as a learning tool in teaching.

After the task forms were submitted, a lesson plan template suitable for the 5E model was given to the pre-service teachers and they were asked to create a lesson plan according to this template. After their experiences of preparing a lesson plan using maps, the post-interview form was prepared to get their opinions and was applied to them at the end of the research process. In the content of the form, the opinions of the teacher candidates about the experiences of preparing a lesson plan using maps, the process they gained in the context of map and mathematical literacy, the positive contributions and disadvantages of the use of maps on mathematics teaching were included.

Data Collection Process

In the first week of the research process, a pre-interview was done with the pre-service teachers. Later, the task form was given to the pre-service teachers and two weeks were given to complete their research. After the task forms were submitted, the pre-service teachers were given a lesson plan template prepared according to the 5E model and they were asked to prepare a lesson plan using a map in the teaching of a subject / attainment objectives they determined. Pre-service teachers were given two weeks to prepare the lesson plan. After the lesson plans were submitted, the pre-service teachers were given a final interview form, and their opinions about their experiences were received and the research process was completed. After the application, the interview form was sent to the pre-service teachers and written opinions of each pre-service teacher were taken. The pre-service teachers were informed about the purpose and process of the research before the interviews, and they were informed that ethical rules would be followed in the data collection and evaluation processes. In the research, data collection tools were applied by taking expert opinion. During the interviews held during the research, utmost care was taken to prevent the participants from being adversely affected.

Data Analysis

Analysis of the research data was done by content analysis, which is one of the qualitative data analysis methods as an analytical approach. Content analysis is defined as a systematic and repeatable technique in which some parts of a content are summarized with smaller content categories with coding based on certain rules, allowing to work indirectly in understanding human behavior and nature (Büyükoztürk et al., 2018). The purpose of content analysis, which enables to reveal previously unidentified themes and to make in-depth analysis of research data, is to reach relationships and concepts in which the data can be explained (Yıldırım & Şimşek, 2016).

Task forms, lesson plans prepared by pre-service teachers, and pre and post interview forms and researcher's observation notes constitute the data sources of the research. Thematic coding was made by creating codes, categories and themes with the data obtained from pre and post interview forms, task forms and lesson plans. The codes were created with the answers given by the pre-service teachers to the semi-structured questions in the forms. Later, the codes related to each other were brought together and thus categories were created. Themes were created by determining the categories related to each other. The data analysis process was done by the researchers. The task form given in the research was applied in order for the teachers to be aware of the curriculum and the textbooks before their experiences of preparing a lesson plan and to conduct research on the subject, and the analysis of this form was not included in the findings section.

The analysis of the prepared lesson plans is given in the findings section in detail. In qualitative research, instead of the concepts of validity and reliability, in accordance with the nature of the research, the concepts of "credibility" and "transferability", "internal reliability" and "external reliability" instead of "internal validity" and "external validity" are used instead of "consistency" and "verifiability" concepts are used (Lincoln & Guba, 1985; Yıldırım & Şimşek, 2016). With this point of view, in order to ensure the credibility of the research, the degree of serving the purpose and the conceptual appropriateness of the questions in the interview forms used in the research was organized taking into account the opinions and opinions of the field education experts and the data collection tools used were finalized. In order to ensure transferability, the data obtained were described in detail, the findings

regarding the experiences and opinions were directly conveyed, and the quotations of the participants were included. In order to ensure consistency, the evaluation of the data obtained in the study was interpreted by two different mathematics education experts and it was observed that the comments were consistent with the comments of the researcher. In order to ensure verifiability, the data obtained from the interview forms and the lesson plans prepared by the pre-service teachers were examined in detail without making any comments or distorting the nature of the data, and the results obtained were supported by direct quotations. The results of the study were tried to be increased by supporting the relevant researches in the literature. In analyzing the data, attention was paid to validity and reliability, and the findings of the study are presented in the following section.

FINDINGS

In this section, the findings obtained as a result of examining the data collected within the scope of the research are presented.

Findings Obtained from the Pre-Interview Form

At the beginning of the research process, the findings obtained from the pre-interview form, which was created to get the opinions of teacher candidates about the use of maps in mathematics teaching, were presented.

When the questions were examined, "What does the map remind you as a pre-service mathematics teacher? What's mathematically on the map?" The answers given by the pre-service teachers to the question given in the form were examined in two different contexts according to what the map evokes and what they found mathematically in the map. When the answers are examined in the connotation theme, the map evokes a tool used to find an address for two pre-service teachers (Aslı and Sena), while the other pre-service teachers evoke map types, scale and location information, map scales, ratio-proportion and distance problems, and transforming the abstract world into a concrete visual. A pre-service teacher (Işıl) stated that she could not establish a connection between map and mathematics. When the answers given by the pre-service teachers about what they found in a map mathematically, it was seen that three of the pre-service teachers (Aslı, Işıl, and Rüya) gave answers in the form of scales and the others in the form of numbers, ratio and proportion, fractions, and various other mathematical concepts. Sample statements chosen among these answers given by the pre-service teachers are given below.

"The map reminds me of concretizing the abstraction of the world by blending it with mathematics."
[Ceren]

"Geography is a lesson very connected with mathematics. Therefore, there are many mathematical concepts on the map. The degrees of the parallels and meridians, the distance between each other, the initial longitude seen as 0 on the number line, local time calculations, the relation of the scale and the map size, the approximate distance between two cities." [Damla]

"Since we never used maps in mathematics lessons in my student life, at first I could not establish a connection between map and mathematics. However, when I examined the attainments, I realized that there might be issues that can be explained with a map. Scales on the map can be associated with the ratio in mathematics." [Işıl]

To the question "Can the map be used as a tool in teaching mathematics? How?" seven of the pre-service teachers gave affirmative answer that it could be used; however, a pre-service teacher (Berna) stated that she did not think that it could be used and even if it could, it would be very limited. The pre-service teachers who gave affirmative answer stated that map could be used in mathematics teaching areas as in problem solving, the concepts of big / small, comparing fractions, graphic drawing, the perpendicular coordinate system, the Pythagorean Theorem and proportion. Selected sample expressions are presented below.

"Frankly, I can't reconcile map and mathematics very much. It cannot be a tool in every subject. By bringing the map to the classroom or opening it on interactive boards, it can be used, for example, in teaching children in terms of big-small concept in mathematics. A connection can be established between a large country and a small country by giving the surface measurements. It can be a visually good tool."
[Aslı]

"Can be used. Even supporting the lesson with a map instead of lecture, it will attract the attention of students, and it can provide a more efficient lesson. Map comes to my mind more about scale. In other words, in the comparison of fractions, it can be used to explain that the larger the denominator, the smaller the ratio. It can be used to find parallel and meridian degrees and coordinates of a place on the earth." [Damla]

"Can be used absolutely. A lecture can be made on the map, for example, many graphics can be drawn depending on population densities by giving a map." [Fatih]

The answers given by the pre-service teachers to the question "Which subjects and concepts can we teach by using maps in mathematics lessons?" are listed for each learning area and presented in Table 1 below.

Table 1. Subjects and concepts that can be taught using maps in mathematics lessons

| Theme | Category | Code | Pre-service Teachers |
|-----------------------|--------------------------|---------------------------------------|-------------------------------|
| Subjects and Concepts | Numbers and Operations | Proportion | Aslı, Berna, Işıl, Rüya, Sena |
| | | Factorization | Ceren |
| | | Fractions | Damla, Fatih |
| | | Percentages | Aslı |
| | Algebra | Coordinate System | Damla, Işıl |
| | | Pythagorean Theorem | Işıl |
| | Geometry and Measurement | Basic Geometric Concepts and Drawings | Berna, Işıl |
| | | Measuring Length & Time | Aslı, Damla, Rüya, Sena |
| | Data Processing | Translation | Ceren |
| | | Reading / Interpreting Graphics | Fatih, Rüya |
| Probability | Probability | Rüya | |

In Table 1, it is seen that the pre-service teachers differ in their preferences about subjects and concepts that can be taught by using map: Five of them for proportions, four of them for measuring length and time, two of them fractions, two of them for coordinate system, two of them for basic geometric concepts and drawings, and two of them for reading / interpreting graphics and one each of them for each of the following subjects: factorization, Pythagorean Theorem, probability, translation and percentages. Sample statements of pre-service teachers are given below.

"Regarding the translation, countries can be translated and we can adapt this system to parallel and meridian on the world. Factors can be found by giving the surface areas of the countries (separation into factors). Actually, if I examine the subjects thoroughly, I think I can put the map on all subjects, but now I am not very knowledgeable." [Ceren]

"We can do something by using maps in subjects like reading graphics, statistics, etc. related to population density. In addition, a study can be done on map scales while explaining fractions." [Fatih]

"We can teach subjects such as probability problems, ratio-proportion, travel-time problems, and drawing graphics." [Rüya]

To the fourth question as *"Which mathematical skills does the use of maps contribute to the development of students?"*, pre-service teachers replied as many mathematical skills. The responses of the pre-service teachers are presented in Table 2 in two categories as general and special skills.

Table 2. Stated mathematical skills for which using map can contribute to their development

| Theme | Category | Code | Pre-service Teachers |
|---------------------|----------------|------------------------------|----------------------|
| Mathematical Skills | General Skills | Higher-order thinking skills | Aslı, Fatih |
| | | Mathematical literacy | Sena |
| | Special Skills | Spatial skills | Aslı, Rüya |
| | | Reasoning skill | Damla, Rüya |
| | | Number and operation skills | Damla, Rüya |
| | | Estimation skills | Berna |
| | | Problem solving skills | Damla |
| | | Connection skill | Işıl |
| | | Representation skill | Ceren |

As seen in Table 2, the general skills expressed by the teacher candidates; higher-order thinking skills and mathematical literacy skills. General skills were stated by three pre-service teachers. Sample statements of pre-service teachers are given below.

"It develops spatial skills since they try to combine mathematics and map. It enables students to think at a high level." [Aslı]

"A new dimension can be brought to mathematical literacy with the use of map." [Sena]

The special skills that pre-service teachers stated are spatial, reasoning, number and operation, estimation, problem solving, connection and representation skills. The sample statement of Rüya among six pre-service teachers who expressed special skills is presented below.

"It contributes to spatial skills, number-processing skills and mathematical reasoning skills." [Rüya]

For the question “*Was map used in your mathematics lessons when you were a pre-college student? If your answer is yes; Please indicate which semester / class / subject.*”, all the pre-service teachers answered as “it was not used”. Before this research, it is understood that the pre-service teachers did not have any idea that map could be a tool in teaching mathematics.

“*What do you think might be the contributions and disadvantages of using maps on mathematics teaching?*” The answers given by the teacher candidates in the question given in the form were examined in two different categories as the contribution and disadvantage of the use of maps on mathematics teaching. The opinions of the teacher candidates are presented in Table 3.

Table 3. The pre-service teachers’ opinions about contributions and disadvantages of using maps on mathematics teaching

| Theme | Category | Codes | Pre-service Teachers |
|-------------------------------|----------|--|--------------------------|
| Positive and Negative Aspects | Positive | Attracting attention to the lesson | Berna, Ceren, Işıl, Sena |
| | | Meaningful and permanent learning | Ceren, Damla |
| | | Facilitating the use of maps in daily life | Rüya, Sena |
| | | Development of mathematical skills | Rüya |
| | | Development of higher-order thinking skills | Aslı, Fatih |
| | | The development of sense of place and direction | Aslı |
| | Negative | It might cause waste of time | Aslı |
| | | It might scare students | Rüya |
| | | For students who don’t like geography, it may cause a bias against the subject | Işıl, Sena |
| | | Students may not understand the subject | Ceren, Fatih |
| | | Not many topics that can be used | Fatih |

As seen in Table 3, pre-service teachers expressed various positive and negative aspects of using maps on mathematics teaching. Two pre-service teachers (Berna and Damla) stated that they do not think using maps have any negative aspect at the moment. Sample statements of pre-service teachers are given below.

“*As a negative aspect, it may be a waste of time. I don't think it might have any other negative aspect. As its positive aspect, it develops feelings of place and direction. It contributes to high-level thinking skills.*” [Aslı]

“*I don't think it has any negative aspect right now. But we can transfer some of the mathematical knowledge we have learned to map and make it more permanent. Since only the scale example comes to mind, I must say that again, things that seem abstract to student when comparing fractions can become more meaningful when he/she realizes that map gets larger and smaller.*” [Damla]

“*The use of maps in mathematics teaching contributes positively to attracting students' attention. When they encounter a map in daily life, it will help them. For example, when they want to go from place to place, they will learn that the distance is not as short as it appears on a map. The downside is that for students who do not like geography and cannot do so, there may be bias towards the subject.*” [Sena]

Findings Obtained from the Task Form

At the beginning of the research process, a task form consisting of three questions was applied to the pre-service teachers. The first two questions in the task form are “*Examine the Elementary Mathematics Lesson Curriculum (5th-8th Grades). What subjects / attainment objectives about map are included in the curriculum? Please write by specifying the subject and outcome.*” and “*Examine the Secondary School Mathematics Textbooks (5th-8th Grades). What are there about maps in the textbooks? Please write by specifying the page number and activity.*” These questions were asked to pre-service teachers in order for them to be aware of the curriculum and textbooks and to conduct research on the subject. The analysis of the data obtained from these questions was left to another research due to its extent and scope, and thus was not included in this research.

In the task form, the pre-service teachers' answers to the third question "If you are asked to use map as a learning tool in your mathematics lesson, how can you use it in which subjects / attainment objectives? Explain (You are expected to provide as much content as possible here)." were examined and the findings obtained are presented in Table 4.

Table 4. Subject / Attainment objectives for which the pre-service teachers prefer to use map as a learning tool in mathematics lesson

| Theme | Category | Code (Attainment Objectives) | Pre-service Teachers |
|--------------------------|---|--|---------------------------------|
| Numbers and Operations | Natural Numbers | M.5.1.1.1. Reads and writes up to nine-digit natural numbers. | Aslı, Ceren |
| | Operations with Natural Numbers | M.5.1.2.1. Performs addition and subtraction with natural numbers up to five digits. | Ceren, Damla, Fatih |
| | Operations with Fractions | M.6.1.5.1. Compares, ranks and displays fractions on the number line. | Damla, Fatih |
| | Percentages | M.5.1.6.2. Associates a percentage expression with a fraction and decimal notation representing the same size, converting these notations into each other. | Aslı, Ceren, Damla |
| | Factors and Multiples | M.6.1.2.5. Determines common divisors and multiples of two natural numbers and solves related problems. | Berna |
| | Sets | M.6.1.3.1. Understands the basic concepts of sets. | Berna, Ceren |
| | Operations with Whole Numbers | M.7.1.1.1. Does addition and subtraction with integers and solves related problems. | Fatih |
| | Rational Numbers | M.7.1.3.2. Does the operations of multiplication and division with rational numbers. | Rüya |
| | Ratio | M.6.1.7.1. Uses ratio to compare multiplicities and shows ratio in different ways. | Aslı, Ceren, Damla, Rüya |
| | Ratio and Proportion | M.7.1.4.2. If given one of two multiplicities whose ratio to each other is given, finds the other. | Berna, Damla, Fatih, Rüya |
| Exponential Expressions | M.8.1.2.5. Expresses and compares very large and very small numbers with scientific notation. | Rüya | |
| Algebra | Linear Equations | M.8.2.2.2. Recognizes the coordinate system with its properties and shows ordered pairs. | Işıl, Sena |
| | Inequalities | M.8.2.3.1. Writes mathematical sentences suitable for daily life situations that include an inequality with a first degree unknown. | Sena |
| Geometry and Measurement | Basic Geometric Concepts and Drawings | M.5.2.1.2. Expresses the position of a point in relation to another point using direction and unit. | Aslı, Ceren, Damla, Fatih, Sena |
| | Triangles and Quadrilaterals | M.8.3.1.5. Writes the Pythagorean equation and solves the related problems. | Ceren, Işıl |
| | | M.5.2.2.1. Names and constructs polygons and recognizes their basic elements. | Berna |
| | Measuring Length and Time | M.5.2.3.1. Recognizes units of measurement of length, converts meter-kilometer, meter-decimeter-centimeter-millimeter units into each other and solves related problems. | Aslı, Damla, Sena |
| | Measuring Area | M.5.2.4.2. Estimates a specified area in units of square centimeters and square meters. | Aslı, Berna, |
| | | M.6.3.2.3. Rerecognizes the units of area measurement, converts the units of $m^2 - km^2$, $m^2 - cm^2 - mm^2$. | Ceren, Damla |
| Transformation Geometry | M.8.3.2.1. Draws the images of points, segments, and other shapes in the translation result. | Fatih Işıl | |
| Data Processing | Data Collection and Evaluation | M.5.3.1.2. Collects data related to research questions and displays it with frequency table and column chart. | Berna |

| | | | |
|-------------|------------------------------|---|-------------|
| | Data Analysis | M.6.4.2.3. Uses arithmetic mean and span to compare and interpret data belonging to two groups. | Fatih, Rüya |
| | | M.7.4.1.3. Creates and interprets a circle chart for a data group. | Rüya |
| Probability | Probability of Simple Events | M.8.5.1.5. Calculates the probability of occurring of a simple event. | Aslı, Rüya |

In Table 4, it is seen that the pre-service teachers preferred to use map as a learning tool in 5th grade with a maximum of 8 objectives in mathematics lesson, then in 6th and 8th grades with 6 objectives and in 7th grade with 4 objectives. When Table 4 is examined in the scope of learning areas, it is seen that the use of maps is preferred at all grade levels in learning numbers and operations at most, then geometry and measurement, and then data processing, then algebra and last, probability in the least.

Findings Obtained from Lesson Plans

In this section, the findings obtained as a result of examining the lesson plans prepared by the pre-service teachers using maps for the mathematics lesson are presented. The lesson plans were examined in terms of grade level, learning area and objectives are prepared for teaching and the mathematical skills aimed to be acquired, and the results are presented in Table 5.

Table 5. Analysis of the lesson plans prepared by the pre-service teachers

| Pre-service Teachers | Grade | Learning Area | Sub Learning Area | Attainment Objectives | Skills |
|----------------------|-------|--------------------------|-------------------------------------|---|--|
| Aslı | 5 | Geometry and Measurement | Basic Geometric Concepts & Drawings | M.5.2.1.2. Expresses the position of a point with respect to another point using direction and unit. | Spatial skill, communication skill, reasoning skill |
| Berna | 6 | Number and operations | Sets | M.6.1.3.1. Understands the basic concepts of sets | Representation skill, connection skill, reasoning skill |
| Ceren | 5 | Number and operations | Percentages | M.5.1.6.1. Displays fractions with a denominator of 100 with percentage symbol (%). M.5.1.6.2. Associates a percentile with a fraction and decimal representation that represent the same magnitude, and converts these representations to each other. | Number and operation skill, reasoning skill, connection skill |
| Damla | 8 | Geometry and Measurement | Translation Geometry | M.8.3.2.1. Draws the images of points, line segments, and other shapes in the translation result. | Spatial skills, reasoning skills, number and operation skill |
| Fatih | 8 | Algebra | Linear Equations | M.8.2.2.2. Recognizes the coordinate system with its properties and shows ordered pairs. | Communication skill, representation skill, reasoning skill |
| Işıl | 8 | Algebra | Linear Equations | M.8.2.2.2. Recognizes the coordinate system with its properties and shows ordered pairs. M.8.3.1.5. Forms the Pythagorean equation and solves related problems. | Reasoning skill, connection skill, number and operation skill, problem solving skill |
| Rüya | 7 | Data Processing | Data Analysis | M.7.4.1.3. Forms and interprets a circle chart for a data group. M.7.4.1.4. Shows the data as a column, circle or line chart and | Reasoning skill, number and operation skill |

| | | | | | |
|------|---|---------|------------------|--|---|
| | | | | prepares suitable conversions about these representations. | |
| Sena | 8 | Algebra | Linear Equations | M.8.2.2.2. Recognizes the coordinate system with its properties and shows ordered pairs. | Reasoning skill, representation skill, problem solving skill estimation skill |

When Table 5 is examined, it is seen that four of the lesson plans prepared by the pre-service teachers were prepared at the 8th grade, two at the 5th grade, and the others at the 6th and 7th grade. When the lesson plans are examined according to the learning areas, it is seen that three of them are prepared in the field of learning algebra, two of them in numbers and operations, two of them in geometry and measurement, and one is in data processing. It is seen that all of the lesson plans prepared in the field of algebra learning were prepared at the 8th grade and for the teaching of the same outcome. Lesson plans prepared in other learning areas are at different grade levels. One of the lesson plans prepared in the field of geometry and measurement is at the 5th grade and the other at the 8th grade. One of the lesson plans prepared in the field of learning numbers and operations is at the 5th grade and the other at the 6th grade. The lesson plan in data processing is at the 7th grade. It is seen that the pre-service teachers prepared a lesson plan at all grade levels and in all learning areas except probability.

Table 6. Findings regarding the lesson plans prepared by using map

| Theme | Category | Code | Pre-service Teachers |
|-----------------------------------|--|--|--|
| Map usage in mathematics teaching | Steps where map is used in 5E Model | Engage step | Aslı, Berna, Işıl, |
| | | Exploration step | Aslı, Ceren, Damla, Fatih, Işıl, Rüya, Sena |
| | | Explanation step | Işıl |
| | | Elaborate step | Aslı, Ceren, Damla, Işıl, Rüya, Sena |
| | The purpose of using map | Evaluate step | Ceren, Işıl, Fatih, Rüya |
| | | Attracting attention | Aslı, Berna, Işıl |
| | | Exploring knowledge through observation and experience | Aslı, Ceren, Damla, Fatih, Işıl, Rüya, Sena |
| | | Making statements on the subject | Işıl |
| | Mathematical skills aimed to have students attain by using map | Connecting the learned information with other disciplines or concepts | Aslı, Ceren, Damla, Işıl, Rüya, Sena |
| | | Evaluating the information learned in other stages and becoming aware of the information | Ceren, Fatih, Işıl, Rüya |
| | | Spatial skill | Aslı, Damla |
| | | Communication skill | Aslı, Fatih |
| | | Reasoning skill | Aslı, Berna, Ceren, Damla, Fatih, Işıl, Rüya, Sena |
| | | Connection skill | Berna, Ceren, Işıl, |
| | | Representation skill | Berna, Fatih, Sena |
| | | Number and operation skill | Ceren, Damla, Işıl, Rüya |
| | | Problem solving skill | Işıl, Sena |
| Estimation skill | Sena | | |

In Table 6, it is seen that the pre-service teachers mostly used maps in the exploration and deepening steps in their lesson plans prepared according to the 5E model. In the explanation step, it is seen that only Işıl used a map among the pre-service teachers. It is seen that Işıl used the map in all steps of the 5E model, while Berna used a map only in the engage stage.

When the lesson plans are examined in the category of the purpose of using map, it is seen that the map is mostly used for exploring information through observation and experience and connecting the learned information with other disciplines or concepts. Later, it is seen that the information learned in the other stages was used for the purpose of evaluating the information and for becoming aware of the information and attracting attention; and the map was used only by one pre-service teacher to make explanations about the subject.

When the lesson plans are analyzed in the category of mathematical skills to be attained by students by using maps, it is seen that all teachers aim to have students attain mathematical reasoning skills in their lesson plans. Then respectively; to attain number and operation skill, connection skill, representation skill, mathematical communication skill, spatial skill and problem solving skill. On the other hand, there is only one pre-service teacher (Sena) who aims to have students attain estimation skills. Examples of each step of the 5E model from the lesson plans prepared by the pre-service teachers using maps are presented below.

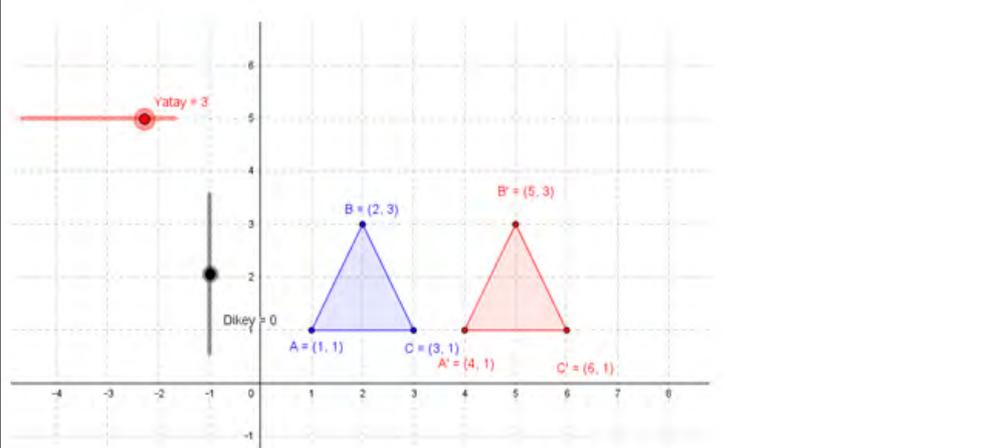
The introduction step of the lesson plan of Berna is given in Figure 1 below:

| | |
|--|---|
| <p>Engage (Motivate- Draw Attention- Stimulate Pre- Knowledge)</p> | <p>The aim is to draw the attention of students to the lesson and arouse their curiosity by using a material belonging to geography in the mathematics lesson, by presenting map images to students without passing on the concepts to be taught and without giving any information about the subject.</p>  <p>After students examine the image, they are asked questions such as “What do you know about the common and different features of regions and cities?” and their opinions are obtained.</p> |
|--|---|

Figure 1. Berna's use of map in the introduction step of her lesson plan

In Figure 1, Berna's introduction step of her lesson plan that she prepared for teaching the attainment objective of "M.6.1.3.1. Understands the basic concepts of sets." is seen. Unlike other pre-service teachers, Berna included the use of maps only in the introduction step of the lesson plan. It is seen that she used the map in the introduction step to draw attention to the subject.

The exploration step of the lesson plan of Damla is given in Figure 2 below.

| | |
|----------------|--|
| <p>Explore</p> | <p>Application is made in Geogebra. As a result of the translation of the object, they are expected to notice the change in the size, shape, direction of the object and the change in the coordinates of the corner points of the object. It is requested to correlate the increase or decrease in the coordinate with the translation movement.</p>  |
|----------------|--|

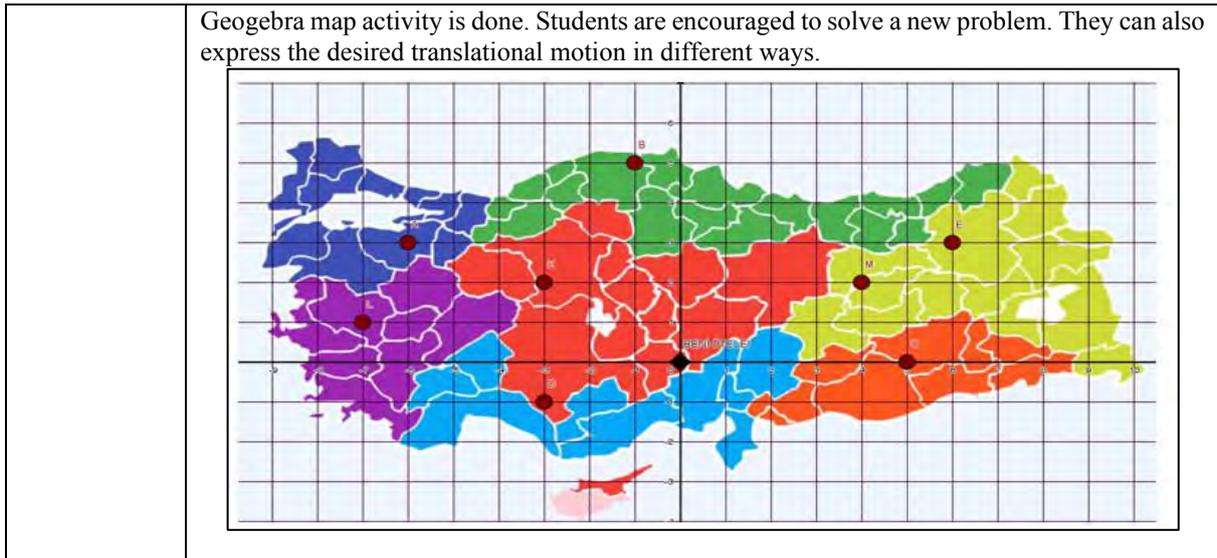


Figure 2. Damla's use of map in the exploration step of her lesson plan

In Figure 2, it is seen the exploration step of the lesson plan that Damla has prepared on the transformation geometry for the teaching of the attainment objective "M.8.3.2.1. Draws the images of points, segments and other shapes as a result of translation. Damla has included the use of maps only in the exploration and deepening steps of the lesson plan she prepared according to the 5E model. In the step of exploring the map, it is seen that students use it to explore information through observation and experience.

The explanation step of the lesson plan of Işıl is given in Figure 3 below.

| | |
|---------|---|
| Explain | <p>At this stage, the teacher gives a lecture about the following outcome.</p> <p><i>Gain 1:</i> Recognizes the coordinate system with its properties and shows ordered pairs.</p> <p>The system formed by the perpendicular intersection of two number lines at the 0 point is called the coordinate system. The intersection point of the number lines is called the origin (origin), the horizontal number line is called the x-axis, and the vertical number line is called the y-axis. To specify the location of a point in the coordinate system, the first of the ordered pairs at the point $A(x,y)$ is chosen from the x-axis and the second from the y-axis. The axes divide the coordinate system into four regions:</p> <p>At the points in the 1st region, x is positive and y is positive. At the points in the 2nd region, x is negative and y is positive. At the points in the 3rd region, x is negative and y is negative. At the points in the 4th region, x is negative and y is negative.</p> <p>Answer the following questions about the cities given in the figure below.</p> <p>1) Write the coordinates of the cities. </p> <p>2) Write in which region the cities are located in the coordinate system. </p> <p>Here, students are expected to apply the knowledge they have discovered.</p> |
|---------|---|

Figure 3. Işıl's use of map in the explanation step of her lesson plan

In Figure 3, the explanation step Işıl's lesson plan is seen for the teaching of the attainment objectives "M.8.2.2.2. Recognizes the coordinate system with its properties and shows ordered pairs. M.8.3.1.5. He creates the Pythagorean relation and solves the related problems.". Işıl is the only pre-service teacher who used a map in the explanation step among other pre-service teachers. It is seen that Işıl used the map to explain the subject to students and to apply the explored information.

The deepening step of the lesson plan of Rüya is given in Figure 4 below.

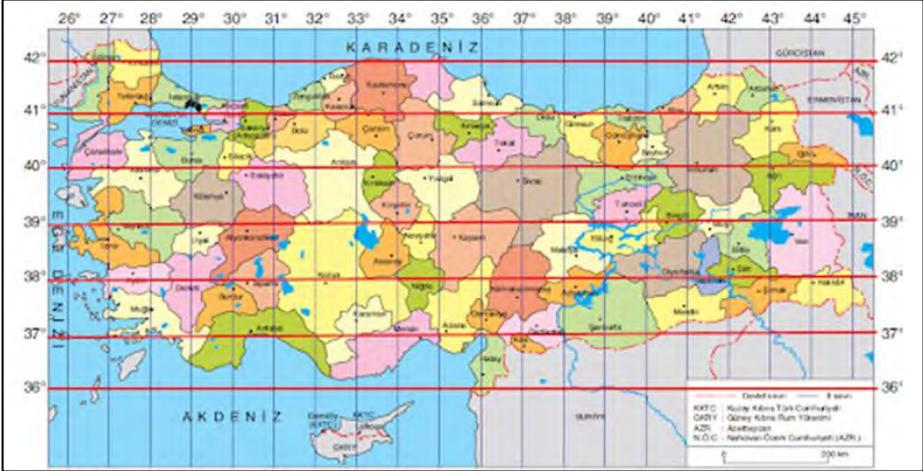
| | |
|-----------|--|
| Elaborate | <p>The activities prepared to observe how much they understand and apply the subject are applied to the students and they go deeper into the subject. A volunteer student is selected to find the desired data in the question and create the circle graph. It is helpful for the city names that they cannot read on the map.</p> <p><i>Activity:</i> The distance between parallels on the same meridian is 111 km. For example, since Aksaray is between a parallel, the distance between its north and south is 111 km. Separate the cities between 33-35 meridians as 111 km and above and below 111 km and place these two data numbers on the circle graph.</p>  |
|-----------|--|

Figure 4. Rüya's use of map in the deepening step of her lesson plan

In Figure 4, the deepening step of Rüya's lesson plan is seen for the teaching of the attainment objectives about data analysis, "M.7.4.1.3. Creates and interprets a circle chart for a data group. M.7.4.1.4. Shows the data as a column, circle or line chart and prepares appropriate conversions about these representations." Rüya included the use of maps in the introduction, deepening and evaluation steps of her lesson plan she prepared according to the 5E model. It is seen that Rüya used the map in the step of deepening to associate the learned information with other disciplines or concepts.

The evaluation step of the lesson plan of Ceren is given in Figure 5 below.

| | |
|----------|--|
| Evaluate |  <p>When they look at this map, what % of the whole map might the red region be expressed as? (We measure how much the student has learned what he or she knows)</p> |
|----------|--|

-We start with simple questions first, progressing from easy to difficult. So I try to understand the level of the class.
 - If $\frac{3}{4}$ of the world is covered with water, what percentage of it is covered with snow?
 - $\frac{1}{4}$ of Turkey's forest areas are in the Black Sea region and $\frac{6}{25}$ of them are in the Mediterranean region. According to this, what percentage of the forest areas in other regions of Turkey constitutes the total forest area? After solving the question, students are given the following map.



With additional questions, I ask myself how much they understand the subject. I evaluate whether the learning achieved through the students' answers has reached its goal.

Figure 5. Ceren's use of map in the evaluation step of her lesson plan

In Figure 5, the evaluation step of Ceren's lesson plan is seen for the teaching of the attainment objectives about percentages "M.5.1.6.1. Displays fractions with a denominator of 100 with a percentage symbol (%). M.5.1.6.2. Connects a percentage expression with a fraction and decimal notation representing the same size, converting these representations into each other." Ceren included the use of maps in the exploration, deepening and evaluation stages of her lesson plan she prepared according to the 5E model. It is seen that she used the map in the evaluation step to evaluate the information learned in the other steps and to realize the knowledge.

Findings Obtained from the Post-Interview Form

In this section, at the end of the research process, the findings obtained from the responses to the questions in the post-interview form, which was created in order to get the opinions of the pre-service teachers about their experiences of preparing a lesson plan in mathematics teaching, were presented.

The answers to the question "What did the lesson plans that you prepared using the map give you in the context of mathematical literacy? Please explain." were examined. The pre-service teachers stated that they gained the ability to read mathematical expressions on the map, that a relationship can be established between mathematics and other lessons very easily, and that a relationship is established with real life by associating maps and mathematics. Sample expressions chosen among the answers given by the teacher candidates are given below.

"Since we used the 5E lesson plan, we worked for students to discover, use and adapt this information in daily life, and we saw the subjects from different perspectives with the expressions of our other friends and we realized how we could use them in our own lessons." [Rüya]

"I started to look at the interpretation of the map-adapted questions that could arise in mathematics from different aspects. We have seen that all of them is actually possible to be expressed with mathematics sentences. We even noticed that maps were formed using concepts in mathematics. For example, in the coordinate system which is my subject, I got them discover that the coordinates of maps were determined according to this system." [Sena]

The answers to the question "What did the lesson plans that you prepared using maps give you in the context of map literacy? Please explain." were examined. The pre-service teachers stated that it was useful to read the expressions on maps and find the positions, they gained the ability to read maps, they learned the concepts related to the map by researching maps, and maps make them realize that there are many subjects that could be used as they examined the map. Pre-service teachers Berna and Fatih stated that they did not gain anything in terms of map literacy. The reason for this was that Berna did not concentrate on the need to read the map due to the subject

she chose, and Fatih stated that the maps used in the lesson plans were intended for 5th, 6th, 7th and 8th grade students, not for adults. Sample expressions chosen among the answers given by the pre-service teacher are given below.

"First, I could only link the map to one or two subjects. I could not think of the subject that could be explained. But as I looked and thought about the map, my ideas expanded. Actually, I realized that there are many topics that can be covered. This gave a different perspective to the map." [Damla]

"How can I use the map?" We also researched maps and learned the concepts of the map, investigated maps in detail and completed the information we knew wrong or incomplete. [Rüya]

"What do you think could be the positive and negative aspects of using maps on mathematics teaching?" The answers given by the pre-service teachers were examined in two categories as opinions about positive and negative aspects. These opinions are presented in Table 7.

Table 7. Opinions about probable positive and negative aspects of using maps in mathematics teaching

| Theme | Category | Code | Pre-service Teachers |
|-------------------------------|----------|---|---------------------------------|
| Positive and Negative Aspects | Positive | Because it is a visually beautiful material, it attracts attention to the subject and increases the permanence of learning. | Aslı, Berna, Ceren, Fatih, Rüya |
| | | It is effective in attracting attention | Berna, Damla, Fatih, Işıl |
| | | It embodies the information to be learned | Damla, Işıl, Sena |
| | | Provides a better understanding of information as it is associated with other disciplines | Aslı, Damla |
| | | Increases the interest in mathematics and provides a better understanding of the subjects. | Ceren, Rüya |
| | | Relates to real life | Sena |
| | Negative | May be time consuming | Aslı, Damla, Işıl |
| | | May confuse students more than usual | Ceren, Fatih |

In Table 7, it can be seen that the pre-service teachers indicate significantly more positive aspects of using maps than their negative aspects in mathematics teaching. In addition, it was found that the negative opinions expressed in the pre-interview (Table 3) decreased in the last interview (Table 7). Also, each pre-service teachers expressed at least one positive opinion, and even, Berna, Rüya and Sena stated that they did not think it had a negative side.

"Do you think using maps in math lessons is enjoyable / fun? Do you think math teachers should use map as a learning tool? Please explain." Only Sena stated that she did not find it enjoyable; but also stated that it should be the first source to be consulted for some subjects. The pre-service teachers Damla, Rüya and Fatih stated that it is a beautiful, interesting and entertaining material; therefore it provides a better understanding of the subjects. Ceren and Işıl stated that learning is achieved by having fun using maps. Aslı and Damla stated that it is a very beautiful and remarkable tool in terms of visibility. Sample expressions chosen among the answers given by the pre-service teachers are given below.

"I think it's definitely fun. In the examples with the map, the students are more interested and thanks to this interest they can better understand the topics and questions." [Fatih]

"I don't think it's a lot of fun, but I think it should be the first reference for some topics. Mathematics teachers should also use maps in the coordinate system while explaining these topics. Because the main source of finding a location on the map is knowing the coordinate well." [Sena]

CONCLUSION AND DISCUSSION

In this part of the research, the results obtained in the light of the findings, discussions and suggestions based on the results of the research are presented. At the beginning of the study, the pre-interview form was applied and the opinions of the pre-service teachers were taken. Later, by giving them task forms and having them prepare a lesson plan, the pre-service teachers were included in the research process, and then the post-interview form was applied and their opinions about the application experiences were taken. The results obtained based on the pre-service teachers' experiences of preparing a lesson plan for using maps in mathematics teaching are summarized below.

When the opinions of the pre-service teachers before their experience of preparing a lesson plan are examined, it is concluded that most of them think that map can be used as a learning tool in mathematics teaching, although they do not have experience in this. It was concluded that pre-service teachers think that the use of maps will contribute to the development of many mathematical skills and competencies in students. Similarly, Çavuş (2019) found that maps are important for students' perception and interpretation of space, and their use in the course

makes the lesson more understandable and increases students' interpretation and inference skills. It was also seen that all of the pre-service teachers expressed different skills, and spatial skills were stated by Aslı and Rüya, mathematical reasoning skills and numeracy and processing skills were stated by Damla and Rüya, and higher-order thinking skills were stated by Aslı and Fatih. It is understood from here that the pre-service teachers have different views on the development of skills that map use contributes to.

When the opinions of the pre-service teachers about the contributions and disadvantages of the use of maps on mathematics teaching were examined, it was seen that the pre-service teachers stated that they would contribute to drawing attention to the lesson the most. It is understood from here that the general opinion of the teacher candidates is that the use of maps will be remarkable. On the other hand, when the answers given by the pre-service teachers are evaluated in general, it is seen that they stated that the subjects taught with the map are learned more easily and that the learning will increase permanence. Gökmen, Budak, and Ertekin (2016) stated in their research that while the use of visual materials helps students learn more easily, they also make learning more permanent. As for the disadvantages of the map on teaching mathematics; it was observed that they stated that the concepts related to map may be biased against the subject or they may be caused by the fact that they are not fully known or not interested in the map.

In the research, it can be concluded that the pre-service teachers have a positive attitude after their experience of preparing a lesson plan for the use of maps as a learning tool in mathematics lessons. The pre-service teachers stated that the process contributed to the preparation of lesson plans and gave them an idea to use map as a learning tool. In addition, pre-service teachers are of the opinion that map can be used as a tool in mathematics teaching and mathematics teachers should use map in their lessons. As a result, pre-service teachers think of using the map in teaching mathematics in their future profession as a result of this experience.

According to the results obtained from the research, it can be said that the opinions of the pre-service teachers about the use of map as a learning tool in mathematics teaching are positive. When the answers are examined, it is seen that the teacher candidates do not have any experience in using maps in mathematics teaching, and it is an important result that the majority of them stated that the map can be used. Only one pre-service teacher (Berna) stated that he did not think that the map could be used in mathematics teaching. Nevertheless, Berna also mentions that the use of maps has a positive contribution to drawing attention to the lesson and that the subject of proportion can be taught by using maps. As can be understood from here, pre-service teachers think that the map can be used as a learning tool in mathematics teaching, it can contribute to the development of many mathematical skills and competencies, and it provides many advantages and has positive contributions. When the previous studies were examined, it was concluded that the use of materials in mathematics teaching contributed to easier, meaningful and permanent learning, and concretized mathematical concepts (Aydoğdu, İskenderoğlu, & Taşkın, 2015; Dienes, 1967; Kennedy & Tipps, 1994; Moyer, 2001; Ünlü, 2017). In addition, pre-service teachers think that the use of material facilitates the expression and learning of the subject, makes meaningful learning, increases retention, attracts students to lesson, encourages students to think and research, and makes the lesson enjoyable (Moyer, 2001; Tutak, Kılıçarslan, Akgül, Güder, & İç, 2012).

In line with the findings and results obtained in this study, we recommend to train practitioners, pre-service teachers at tending the education faculties of universities for the use map as a material in mathematics teaching. Thus, it can be ensured that pre-service teachers graduate ready to give interdisciplinary lessons. For researchers, we recommend to conduct a similar study with mathematics teachers. In addition, similar studies can be conducted in which the lesson plans created by using map for the mathematics lesson are applied to middle school students and their opinions are taken.

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