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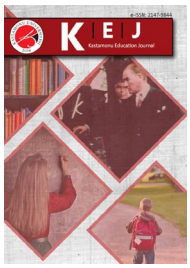

| Research Article / Araştırma Makalesi |

Opinions of Classroom Teacher Candidates on STEM Education

STEM Eğitimine Yönelik Sınıf Öğretmeni Adaylarının Görüşleri

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Keywords
1.Stem
2.Stem Education
3.Teacher Candidate
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Abstract

Purpose: Scientific and technological developments in the last century have undoubtedly been realized in the light of new paradigms that have taken place in education programs. Especially advances in science, technology, engineering and mathematics have been transformed into new inventions and products. From this point of view, STEM, which has become an important education discipline by combining the fields of science, technology, engineering and mathematics, has enabled learners to absorb, synthesize and apply the information they have acquired with an interdisciplinary perspective. It is considered important and necessary to learn. Based on this idea, this study was conducted in order to examine the opinions of teacher candidates studying in the primary school teaching department about STEM education after STEM education.

Design/Methodology/Approach: This research is a qualitative study aimed at determining the opinions of teacher candidates on STEM education. The study was conducted based on a case study, one of the qualitative research methods. Working group of the study consisted of 57 teacher candidates educating at a state university in southern Turkey. The sample of the study was determined by the criterion sampling method, one of the purposeful sampling methods.

Findings: It was concluded that the classroom teacher candidates generally thought that STEM education was related to science, technology, engineering and mathematics fields, that it included daily life lesson problems, that it gave teacher skills, provided permanent learning and gained perspectives. In addition, it was concluded that in the case of applying STEM activities in mathematic lessons, both teachers and teaching time management may have problems in the context of preparing headings individually.

Highlights: According to these results, applied trainings can be given to both in-service processes and teacher candidates and teachers to solve such problems. In addition, this study turned out to be about the participants following education in the classroom teaching department. In cooperation with students studying in mathematics, science and engineering departments on STEM education, new studies can also be conducted to examine their thoughts on STEM education and applications.

Öz

Çalışmanın amacı: Son yüzyılda yaşanan bilimsel ve teknolojik gelişmeler şüphesiz eğitim programlarında yerini alan yeni paradigmalar ışığında gerçekleşmiştir. Özellikle fen, teknoloji, mühendislik ve matematik alanlarında gerçekleşen ilerlemeler yeni buluş ve ürünlere dönüştürülmüştür. Bu açıdan bakıldığında, kısaca fen, teknoloji, mühendislik ve matematik alanlarının birleştirilmesiyle önemli bir eğitim disiplini halini alan STEM, öğrenenlerin disiplinler arası bakış açısıyla edindiği bilgileri özümsemesini, sentezlemesini ve uygulamasını sağlamıştır Özellikle ilköğretim öğrencileri için en önemli etmenlerden biri olan sınıf öğretmeni adaylarına STEM konusundaki düşüncelerinin öğrenilmesinin önemli ve gerekli olduğu düşünülmektedir. Bu düşünceden yola çıkarak bu araştırma STEM eğitimi uygulamaları sonrası, sınıf öğretmenliği bölümünde öğrenim gören öğretmen adaylarının STEM eğitimine yönelik görüşlerinin neler olduğunu incelemek amacıyla yapılmıştır.

Materyal ve Yöntem: Bu araştırma, STEM eğitimi konusunda öğretmen adaylarının düşüncelerini belirlemeye yönelik nitel bir çalışmadır. Çalışma nitel araştırma yöntemlerinden durum çalışmasına dayalı olarak yürütülmüştür. Araştırmanın çalışma grubunu Türkiye'nin güneyinde bir devlet üniversitesinin sınıf öğretmenliği ana bilim dalında öğrenimlerine devam eden 57 öğretmen adayı oluşturmaktadır. Araştırmanın örneklemi amaçlı örneklem yöntemlerinden ölçüt örnekleme yöntemi ile belirlenmiştir.

*Bulgular: S*ınıf öğretmeni adaylarının genel olarak STEM eğitiminin fen, teknoloji, mühendislik ve matematik alanları ile ilgili olduğunu, günlük hayatla ilişkili problemleri kapsadığını, öğrencilere çeşitli beceriler kazandırdığını, kalıcı öğrenme sağladığını ve farklı bakış açıları kazandırdığını düşündükleri sonucuna ulaşılmıştır. Ayrıca, STEM etkinliklerinin matematik derslerinde uygulanabilme durumunda hem öğretmenlerin hem de öğrencilerin zaman yönetimi, bireysel farklılıklarla başa çıkma, etkinlik hazırlama bağlamında sorunlar yaşayabilecekleri sonucuna ulaşılmıştır.

Önemli Vurgular: Bu araştırma sonuçlarına göre öğretmen adayları ve öğretmenlere STEM etkinliklerinin hazırlanmasına yönelik eğitimler verilebilir. Ayrıca, bu çalışma sınıf öğretmenliği bölümünde öğrenim gören katılımcılar ile yürütülmüştür. STEM eğitimi konusunda matematik, fen bilgisi, mühendislik bölümlerinde öğrenim gören öğrencilerle işbirliği yapılarak onların STEM eğitimi ve uygulamaları hakkındaki düşüncelerini irdeleyen yeni araştırmalar yapılabilir.

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INTRODUCTION

Scientific and technological developments in the last century have undoubtedly been realized in the light of new paradigms that have taken place in education programs. Advances in science, technology, engineering and mathematics have been transformed into new inventions and products. From this point of view, STEM, which has become an important education discipline by combining the fields of science, technology, engineering and mathematics, has enabled learners to absorb, synthesize and apply the information they have acquired from an interdisciplinary perspective (MEB, 2016).

By bringing together different scientific disciplines, STEM education aims to enable students to solve practical skills that they can use in real life and to solve theoretical problems they may encounter in the future and to prepare new technological inventions (Bybee, 2010; Capraro & Slough, 2008; Sanders, 2008; Stolhmann, Moore & Roehrig, 2012; Şahin, Ayar and Adıgüzel, 2014). In this context, STEM education enables students to have multiple perspectives and to use the information obtained from different disciplines in the problem solving process (Lacey & Wright, 2009; Wang, 2012). In addition, based on a student-centered educational approach, STEM education is seen as an important tool for economic development and scientific leadership as well as providing individuals with knowledge and skills from an interdisciplinary perspective (Brophy, Klein, Portsmore & Rogers, 2008; Wang, 2012). In this context, it is clearly seen that many countries that integrate STEM education into their educational policies (such as Europe, America, England, Japan) have made progress in the economic field, and that there are significant increases in the favor of their students in PISA and TIMSS exam results, which measure students' competencies in mathematics and science (Kennedy & Odell, 2014; Wang, Guo & Jou, 2015).

In the context of our country, STEM education is given great importance both in universities and in in-service training, as in many countries. (Akaygün & Aslan Tutak, 2016; Özbilen, 2018). In order for this process to function effectively, STEM must be integrated into curriculum and students must have the necessary competencies for the process (Çepni, 2017; Stolhmann, Moore & Roehrig, 2012; Zarske, Sullivan, Carlson, & Yowell, 2004). In this context, the use of STEM education and applications in mathematic lessons from pre-school to higher education levels is becoming increasingly common in our country (Akgündüz & Ertepınar, 2015; Gonzalez & Kuenzi, 2012; Kennedy & Odell, 2014). However, Rockland et al. (2010) state that teachers do not receive sufficient training on how to apply STEM education in the classroom. Today, there is a need for teachers who are open to learning and innovations, who have scientific process skills, problem solving skills, and ability to work collaboratively. From this point of view, it is important for teachers to gain the knowledge and skills of their own branches to students in collaboration with experts from other disciplines (Becker & Park, 2011; Stohlman, Moore & Roehrig, 2012). The most critical period in the development of students' attitudes and interests towards STEM is the primary school period (Geiger, 2019; Miller, 2019; Moore, Johnston, & Glancy, 2020). Therefore, primary school teachers' interests and perceptions about STEM are correct; It is thought that it is important to eliminate the deficiencies, if any.

When the literature on STEM approach is examined; most of the national and international studies conducted are students (Cho & Lee 2013; Cotabish, Dailey, Robinson & Hunghes, 2013; Gümüş, 2019; Miller, 2019; Priatna, Lorenzia & Widodo, 2020; Yılmaz, Gülgün & Çağlar, 2017) and teachers (Bakırcı & Kutlu, 2018; Du Plessis, 2018; Geiger, 2019; Köse & Ataş, 2020; Nguyen, Nguyen & Tran, 2020; Park, Byun, Sim, Han & Baek, 2016; Siew, Amir & Chong, 2015; Yıldırım, 2017; Stohlmann, 2018; Stohlmann, Moore & Roehrig, 2012; Wang, 2012; Weber, 2015). However, it is seen that studies on teacher candidates (Akaygün & Aslan Tutak, 2016; Bergsten & Frejd, 2019; Buyruk & Korkmaz, 2018; Yıldırım, 2017) are quite limited. For example; Bergsten and Frejd (2019), as a result of their research with mathematics teacher candidates in Sweden, concluded that teacher candidates were successful in designing STEM activities by integrating their twenty-first century skills with mathematics. Similarly, Evans (2005), as a result of his research conducted with classroom teacher candidates, concluded that teacher candidates' perceptions, attitudes and abilities about education with STEM are positive.

As can be seen from the studies mentioned above, it is thought that it is important and necessary to learn the opinions of classroom teacher candidates on STEM, which is one of the most important factors especially for primary school students. Based on this idea, this study was conducted in order to examine the opinions of teacher candidates studying in the primary school teaching department about STEM education after STEM education applications. Sub-problems of the research;

1) What are the opinions of teacher candidates about STEM education in general?

2) What are the opinions of the teacher candidates about the adequacy of mathematical knowledge in the preparation process of STEM activities?

3) What are the opinions of the teacher candidates regarding the applicability of STEM activities in mathematic lessons?

4) What are the opinions of teacher candidates regarding the applicability of STEM activities in mathematic lessons in terms of teachers?

5) What are the opinions of teacher candidates about the state of using STEM activities in the context of mathematic lessons in their professional lives?

METHOD/MATERIALS

This research is a qualitative study aimed at determining the opinions of teacher candidates on STEM education. The study was conducted based on a case study, one of the qualitative research methods. Case study is applied in order to examine the reasons of an event, situation or problem in depth (Merriam, 2013). In this study, primary school teacher candidates' views on STEM education and applications were applied in depth.

Working Group

The study was conducted based on a case study, one of the qualitative research methods. Working group of the study consisted of 57 teacher candidates educating at a state university in southern Turkey. The sample of the study was determined by criterion sampling method, one of the purposeful sampling methods. The purpose of the purposeful sampling is to collect the most accurate information about the individual, phenomenon or situation directly related to the subject of the study (Maxwell, 1996). As a criterion, having not attended STEM education before, information technologies, basic mathematics in primary school, science teaching and mathematics teaching I courses and being successful were taken into account. 46 of these participants are women and 11 of them are men and their ages vary between 17 and 23. Participants' GPA (Grade Point Average) ranges between 2.72 and 3.39.

Data Collection and Application

In this study, a six-hour program on STEM education was prepared. The activities in this program were prepared to include geometry teaching and measurement teaching subjects within the scope of mathematics teaching course to teacher candidates. In the program prepared, general information about STEM education, how the STEM learning teaching process is and how the lesson plans should be prepared were given to the students in the first three hours. In the other three hours, the sample applications within the scope of STEM education were examined and discussed in the classroom after evaluating the subject. At the last stage, sample STEM applications were made to teacher candidates using their knowledge on geometry and dimensions.

Data Collection Tool and Analysis

Within the scope of the study, a semi-structured interview form on STEM developed by the researcher was used as a data collection tool. While creating this form, the literature was first reviewed. After the literature review, the first trial form was created. The trial form was asked to two experts working in the field of STEM education. Experts evaluated the appropriateness, clarity, comprehensibility and content validity of the questions. In this context, the form was finalized in line with the feedback from the experts. This final form was applied to two teacher candidates as a pilot study. As a result of the application, a few corrections were made and the interview form was finalized. The questions in the interview form; the general views of the participants on STEM education are related to the adequacy of mathematical knowledge in the case of preparing such activities and the situation of the participants to include such activities in their professional lives.

Participants were asked to state their opinions in writing about the questions in the semi-structured interview form on STEM. Descriptive analysis was used to analyze the data obtained. Descriptive analysis is the process of summarizing and interpreting data based on predetermined themes that can be obtained with many data collection tools such as interview, observation and document analysis (Yıldırım & Şimşek, 2003). Within the scope of this study, first of all, a general framework has been created based on research questions. It has been determined in which categories the data obtained within the scope of this framework can be.

In the next stage, meaningful and logical codes were arranged in accordance with the categories prepared using the relevant literature. In order to allow comparison of the categories arranged, the data were arranged in tables and the opinions of the students were stated in the context of the frequency level under each code. Then, where necessary, the findings were presented by placing students' explanations through direct quotations (Yıldırım & Şimşek, 2003). The form number and gender of the relevant participant were coded in the Semi-Structured Interview Form on STEM. For example, E1 male participant first form was coded as K1 female participant first form.

Expert control is important in ensuring the reliability of data analysis (Creswell, 2013). In this direction, a mathematics educator experienced in qualitative research worked as the second coder and analyzed all data separately. For the agreement rate between the two coders, the agreement was calculated with the formula of Agreement Percentage=Agreement/(Agreement+Disagreement)*100 stated by Miles and Huberman (1996) and this value was found as .92. The fact that this value is at least .70 is an indication that the encoding is reliable. In addition, in cases where there was a difference of opinion, it was agreed by making a joint decision on what the code would be.

Within the scope of the ethical measures taken during the research process, the necessary official permissions were obtained from the ethics committee. In addition, at the beginning of the study, all participants were informed about the purpose of the study, the implementation process and how to collect data. Volunteerism was taken into consideration for participation in the study. On the other hand, codes were used to keep the identities of the teacher candidates participating in the study secret. It has been stated that all the data obtained will be used only within the scope of this research.

FINDINGS

The data obtained from the opinions of the participants in line with the sub-objectives of the research are given below. In this regard, first of all, the participants were asked what they think about STEM education in general. The opinions of the participants on this issue are presented in Table 1.

Table 1. Participants' General Views on STEM Education

Category	Codes	f
STEM Education	A teaching model that can solve problems related to daily life with a scientific perspective	21
	An understanding that includes the fields of Science, Technology, Engineering and Mathematics	20
	All of the sciences related to numerical fields	18
	An approach to the fields of Science, Technology, Engineering and Mathematics	10
	An understanding that different disciplines are used together and that gives students skills	8
	An education system	5

According to Table 1, with regard to STEM education, the participants mostly stated that "the teaching model that can solve problems related to daily life from a scientific point of view" (f=21), "science, technology, engineering and mathematics fields" (f=20) and stated that "the whole of the sciences related to numerical fields" (f=18). For this, the view of the participant K19 is as follows: "*It is a system that aims to remove the fields of science, mathematics, engineering and technology from the memorization system, to improve the applicability of information in real life and to develop problem solving techniques, and to highlight the features of curiosity, research and creativity*". On the other hand, five of the participants stated that STEM education is "an education system" (f=5). In this regard, the participant E3 coded "*It is an education system formed by the combination of fields such as science, technology, and mathematics*" expressed his opinion in the form.

As the second sub-aim of the research, the opinions of the participants about the adequacy of mathematical knowledge in the process of preparing activities for STEM education are included in Table 2.

Table 2. Participant Views on the Adequacy of Mathematical Knowledge in STEM Activities

Category	Codes	f
Insufficient Mathematical Knowledge	Knowledge of other disciplines required (such as science, technology, engineering and arts)	43
	Skill required (problem solving, manual dexterity, creativity, visualization)	8
	Necessary to associate with everyday life	4
Sufficient Mathematical Knowledge	Mathematics field knowledge must be sufficient	3

According to Table 2, the participants who stated that mathematical knowledge was not sufficient in the process of preparing STEM activities, in addition to mathematical knowledge, mostly pointed "knowledge about other disciplines" (f=43), "skill required" (f=8) and "necessary to associate with daily life" (f=4) codes. The opinion of the participant K4 on this subject is as follows: "*Mathematical knowledge alone will not be sufficient. For example, in the construction process of an activity such as bridge construction, science will also help in points such as gravity, effect of objects on each other and weight. In addition, the properties of the materials used will also have an effect. Visual arts should be used in terms of the appearance of the bridge. Engineering and architectural knowledge will also be useful in bridges that are larger and aesthetically beautiful*". On the other hand, three participants who participated in the study emphasized that mathematical knowledge is sufficient in the process of preparing activities in the context of STEM education. In this context, for example, the participant K7 coded "*Mathematics and geometry knowledge will be sufficient. For example, the information we will use when making the bridge activity includes mathematical knowledge in terms of geometric shapes and equality in the formation of shapes in bridges*" stated her opinion in the form.

Within the scope of the third sub-purpose of the research, the participants' views on the application of STEM activities in mathematic lessons in terms of students are presented in Table 3.

Table 3. Participants' Views Regarding the Applicability of STEM Activities in Mathematic Lessons from the Perspective of Students

Categories	Codes	f
Student Dimension	Students' ability to gain skills (such as problem solving, thinking skills, communication, creative thinking, leadership, creativity, manual skills)	13
	Recognizing the importance of interdisciplinary interaction	12
	Gaining a different perspective and experience	9
	Students collaborating	3
Learning-Teaching Process	Relating lessons to daily life	17
	Permanent learning	10
Experienced Difficulties	Takes Time	7
	Difficulty reaching the material	2
	High cost	1

When Table 3 is examined, the views of the participants about the applicability of STEM activities in mathematic lessons in terms of students are discussed in three categories. In this context, when the first category is examined; Participants STEM education "students gain skills" (f=13) and "realizing the importance of interdisciplinary interaction" (f=12), "gaining different perspectives and experiences" (f=9) and "students' cooperation" (f=3) stated that it was beneficial for students in their subjects. For example, the K8 coded participant's opinion on this subject states that "*With the help of such activities, the student begins to*

think more critically, more problem-solving, more assertive and versatile. He also realizes that they need to use their knowledge of mathematics, science, engineering, and arts that make everyday life easier. In addition, the student's science, mathematics and technology literacy levels also increase" expressed in the form.

Secondly, in the category of learning-teaching process, the participants mostly drew attention to the codes "lessons are associated with daily life" (f=17) and "provide permanent learning" (f=10). In this regard, for example, the participant's opinion coded K18 "*Such activities can actually bring many things to the student at the same time. One of them can learn by observing the functioning of the mathematics and geometry lesson that comes across in school life in daily life. Besides, it can add many things to the imagination in terms of geometry*" expressed in the form.

Finally, in the category of difficulties, the participants stated that they mostly experienced problems with "taking time" (f=7), "difficulty in accessing the material" (f=2) and "high cost" (f=1). In this regard, the participant E6 expressed his opinion as "The activities are very challenging and take time compared to the traditional method", while the participant K5 stated that "*For the student, it is an important problem that these activities require effort and the cost of tools to be used in the activities is high".* She expressed her opinion in the form.

Within the scope of the fourth sub-aim of the research, the views of the participants about the application of STEM activities in mathematic lessons in terms of teachers are presented in Table 4.

Table 4. Participant Views Regarding the Applicability of STEM Activities in Mathematic Lessons from the Perspective of Teacher

Categories	Codes	f
Student Dimension	Knowing about students	11
	Providing students with skills	5
Learning-Teaching Process	Relating to daily life	8
	Being able to be taught by concretizing	7
	Being permanent	6
	Have fun	2
	Decreased prejudices against mathematics	1
Teacher Dimension	Improving perspective	5
	Encountering creative and different ideas	3
Experienced Difficulties	Difficulty in Time Management	6
	Not enough hardware (Such as computer, material)	3
	Encountering individual difference	2
	Activity preparation process	1

When Table 4 is examined, the views of the teachers about the applicability of STEM activities in mathematic lessons are collected in four categories. Accordingly, the participants drew attention to the codes of "having information about students" (f=11) and "ability to gain skills for students" (f=5) in the student category. In this context, for example, the participant K2 stated that "*we can have an idea about how students use their minds*". Secondly, in the learning-teaching category, the participants were mostly "associating lessons with daily life" (f=8), "being able to be taught by concretizing" (f=7), "being permanent" (f=6), "having fun" (f=2) and "decreasing prejudices against mathematics" (f=2). In this context, for example, the participant K25 coded "*It provides the teacher with the opportunity to teach more easily since it will cause students to learn by experiencing. Thus, the subject is concretized and taught permanently*". She expressed her opinion in the form. Thirdly, in the teacher theme, the participants mostly focused on the codes of "improving perspective" (f=5) and "encountering creative and different ideas" (f=3). In this context, for example, the participant E3 coded "*With this kind of studies, teachers can have an idea about how their students use their minds. At the same time, it can gain a versatile perspective on students*" expressed his opinion in the form. Lastly, in the category of difficulties, the participants mostly stated that "difficulty in time management" (f=6), "not enough hardware" (f=3), "encountering individual differences" (f=2) and "activity preparation process" (f=1) pointed out the codes. In this regard, for example, participant K6 "*also provides teachers with a versatile perspective. However, if the teacher does not have enough equipment in such activities and cannot cooperate with experts in other disciplines, he/she will have a hard time preparing these activities*" stated her opinion in the form.

Within the scope of the last sub-purpose of the research, the opinions of the participants about the situation of using STEM activities in mathematic lessons in their professional lives are given in Table 5.

Table 5.Participant Views Regarding the Use of STEM Activities in Their Professional Life

Category	Codes	f
Usable	Gaining skills	13
	Permanent learning	10
	Associating with daily life	9
	Increasing motivation	6
	Getting to know students closely	3
	Being a measurement and evaluation tool	2
Depends on Conditions	Takes time	6
	Equipped	3
	Lack of material	2

As seen in Table 5, the majority of the participants (f=43) stated that they could use STEM activities in their professional lives. Accordingly, the participants mostly emphasized the importance of effects such as "gaining skills" (f=13), "permanent learning" (f=10), "associating with daily life" (f=9) and "increasing motivation" (f=6). In this direction, the participant K3 coded "*Of course I can use it. Because such projects are great opportunities to create significant changes in both teachers 'and students' perspective on mathematics. I also show that mathematics actually exists in nature. I will improve my students' manual skills. I will show that we can do different things as we want with the materials we have. I let them use their imagination. I would show that mathematics is used in different professions*" stated her opinion in the form. On the other hand, six of the participants stated that they can use STEM-based activities depending on the conditions, it may take time, three of them stated that they should be equipped and both of them stated that there might be a lack of material. For example, the participant with the code K17 said, "*If the event we will do will have a problem in terms of time, I may not use it*" expressed her opinion in the form.

DISCUSSION

This research was conducted to examine the opinions of classroom teacher candidates on STEM education and applications. As a result of the research, the participants generally; they stated that STEM education is related to the fields of science, technology, engineering and mathematics; it covers problems related to daily life and gives students various skills. These results are also similar to the relevant literature (Hacıoğlu & Başpınar, 2020; Karademir Coşkun, Alakurt & Yılmaz, 2020; Köse & Ataş, 2020; Nguyen, Nguyen & Tran, 2020; Park et al., 2016; Siew et al., 2015; Yıldırım, 2017; Yılmaz et al., 2017; Wang, 2012). In this regard, for example, Yıldırım (2017) reached the conclusion that students will provide permanent learning and actively participate in classes as a result of his study examining the opinions of teacher candidates on STEM education. Similarly, Karademir Coşkun et al. (2020), in their studies on STEM applications, concluded that students can learn permanently, improve their problem-solving skills and their academic skills with the help of STEM education.

According to the second sub-aim of the study, most of the participants clearly stated that their mathematics knowledge was not sufficient and they needed knowledge and skills related to many disciplines such as science, technology and engineering during the preparation process of STEM activities. This result is similar to the studies conducted in the literature (Bakırcı & Kutlu, 2018; Köse & Ataş, 2020; Kızılay, 2018; Stohlmann, 2018; Özbilen, 2018). In this context, for example, Özbilen (2018) stated in his study that the theoretical knowledge learned only in mathematics and science fields is not enough for those who learn in the process of STEM applications; He concluded that engineering applications are also indispensable in practice in order to associate the acquired knowledge with daily life. In addition, Stohlmann (2018) emphasized the importance of associating mathematics with other disciplines in STEM education and proposes different models on this issue.

On the other hand, regarding the applicability of STEM activities in mathematic lessons in terms of students, it was concluded that it is very useful for students to gain skills, to realize the importance of interdisciplinary interaction, to gain different perspectives, to gain experience and to cooperate in this process. This result is also similar to the results of the studies in the literature (Bakırcı & Kutlu, 2018; Cotabish et al., 2013; Hacıoğlu & Başpınar, 2020; Kim & Choi, 2012; Park et al., 2016; Siew et al., 2015; Yıldırım and Türk , 2018; Wang, 2012). In this regard, for example, Cotabish et al. (2013) STEM education in increasing the academic success of students. They concluded that it is an important factor in developing process and inquiry skills. Similarly, Wang (2012) concluded in his study that teachers could conduct their lessons more effectively by associating STEM activities with daily life and students acquired meaningful learning. Again, Yıldırım and Türk (2018) stated that STEM education is an important factor for students to acquire many skills such as thinking and problem solving; they also found that STEM activities increased the motivation of students and also improved their cooperation skills.

Another important result obtained from the study is that STEM activities can combine mathematic lesson with daily life and thus provide permanent learning. This result is similar to the studies conducted in the literature (Özbilen, 2018; Yıldırım, 2017; Yıldırım & Altun, 2015; Wang, 2012). In this context, for example, Wang (2012) found in his study that teachers made the lessons more meaningful for students by associating STEM activities with daily life. Similarly, Yıldırım and Altun (2015) concluded in their study that STEM education increased students' success in the classroom.

On the other hand, during the implementation of STEM activities, the participants pointed to similar problems in both student and teacher dimensions. Accordingly, the participants pointed out that STEM application may take time for the students or there may be problems in accessing the necessary materials in the preparation of such activities. Similarly, the participants emphasized that teachers may have problems in time management, in having sufficient equipment, in preparing activities, in organizing activities suitable for students' individual differences. This result is similar to the studies in the literature (Hacıoğlu & Başpınar, 2020; Karademir Coşkun et al., 2020; Köse & Ataş, 2020; Özbilen, 2018; Park et al., 2016; Siew et al., 2015; Yıldırım, 2017). In this context, for example, Park et al. (2016) concluded in their study that Korean teachers had problems in finding time and accessing necessary materials during the implementation of STEM education.

According to the last sub-purpose of the study, most of the participants emphasized that they can use STEM activities in their professional lives. However, a few participants stated that they could carry out STEM activities in their professional lives due to the lack of time, equipment and materials. This result is similar to the studies in the literature (Özbilen, 2018; Park et al., 2016; Yıldırım, 2018; Yıldırım & Türk, 2018; Stolhmann et al., 2012). In this context, for example, Yıldırım (2018) revealed that during the implementation of STEM activities, teachers experienced problems due to the physical structure of the classroom, class size and time. Again, Yıldırım and Türk (2018) stated that the majority of teacher candidates want to include STEM-related studies in their

professional lives; however, some of them found out that they thought they did not have enough knowledge on this subject and could not use them in their lessons.

CONCLUSION AND RECOMMENDATIONS

In summary, in the study, it was concluded that the classroom teacher candidates generally thought that STEM education is related to science, technology, engineering and mathematics fields, it covers problems related to daily life, provides students with various skills, provides permanent learning and gives them a different perspective. In addition, it was concluded that if STEM activities can be applied in mathematic lessons, both teachers and students may experience problems in terms of time management, coping with individual differences, and activity preparation. For this reason, both teacher candidates and teachers can be given practical training to eliminate such problems. Finally, this study was carried out with the participants studying in the classroom teaching department. In cooperation with students studying in mathematics, science and engineering departments on STEM education, new studies can also be conducted to examine their views on STEM education and applications.

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The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Statements of publication ethics

I hereby declare that the study has not unethical issues and that research and publication ethics have been observed carefully.

Author's Contributions

There is only one author of this article. Ayten Pınar BAL is responsible for all of the work done for this article.

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