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The Opinions of Mathematics Teacher Candidates Who Have Received a STEM Training on STEM and the Activities they Designed in the Class

By Betül Küçük Demir[*]

This study has been conducted to investigate the opinions of mathematics teacher candidates on science, technology, engineering and mathematics (STEM) training and the activities designed by them. It has been carried out using the case study method, which is one of the qualitative research patterns. In this study, semi-structured interview forms and activity cards have been used to gather data. While semi-structured interview forms served to elicit teacher candidates' opinions on STEM, activity cards were employed to ask them to design an activity in which they could put their training on STEM into practice. The study has been conducted with 34 senior mathematics education students and the data obtained have been analyzed using the content analysis method. It has been concluded that mathematics teacher candidates have positive views on STEM training. The activities designed by the candidate teachers can be categorized under four categories, which are interdisciplinary, the engineering field it is related to, the preferred method and the activities that are not suitable for STEM. Teacher candidates should be trained on how to integrate STEM education into their lessons. Stem activity examples should be presented to teacher candidates for applicability.

Keywords: Mathematics teacher candidate, stem, activity, training, opinion

Introduction

It is a widely accepted fact that knowledge is a necessity in an age of rapid advancement for everyone wanting to keep up with these advances because we are living in an age when knowledge is considered as power. In today's economy, which is relatively more global, more technological and more competitive, it is critical to progress in the disciplines of science, technology, engineering and mathematics (Raines, 2012). The necessity of combined efforts in such fields as science, technology, engineering and mathematics to find solutions to the problems in this ever-globalizing world is a natural result of this situation (Moore et al., 2014). In order to compete in the 21st century, countries need an innovative STEM workforce (Çorlu, Capraro & Capraro, 2014).

STEM is a term which first started to be used in the 1990s by the National Science Foundation (NSF) as an acronym that stands for science, technology, engineering and mathematics (Bybee, 2013). STEM education, whose importance has been increasing in recent years, involves the integration of science, technology, engineering and mathematics with one another. As STEM blurs the line between disciplines by nature, integration is thought to be more in harmony with the nature of STEM (Wang, 2012). STEM is a whole new discipline which is connected to other disciplines (Morrison, 2006). Based on the integration of disciplines, STEM education aims to make a connection between disciplines so

[*]Assistant Professor, Bayburt University, Turkey.

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that learning can be connected, focused, meaningful and relevant to learners (Smith & Karr-Kidwell). It is an integrative approach which is translated into Turkish as FeTEMM (standing for Fen, Teknoloji, Matematik, Mühendislik Eğitimi), and helps students to adopt creative problem solving techniques (Akgündüz et al., 2015; Gülhan & Şahin, 2016). STEM education is an integrative approach aiming to make students, who are going to be the future innovators, embrace creative problem solving techniques (Roberts, 2012). STEM education covers the knowledge, skills and beliefs which are collaboratively formed at the intersection of more than one STEM area (Çorlu, Capraro & Capraro, 2014). While it mainly focuses on the disciplines of science and mathematics, STEM education also includes the areas of technology and engineering (Bybee, 2010b). Being able to align with contemporary educational standards and direct major components of educational reform, STEM has a significant potential for innovation in education (Bybee, 2013). STEM education aims for students to gain a multidisciplinary perspective when faced with problems and to acquire the necessary knowledge and skills (Şahin, Ayar & Adıgüzel, 2014). Instructional programs which are formed by joining more than one discipline in an interconnected way enable students to be informed about various areas and develop their problem solving and cooperative learning skills as well as increase their interest and motivation (Niess, 2005). As stated by Çorlu et al. (2012), STEM education is at the core of the reforms intending to raise a generation with the ability to innovate and thus, the scope and the theories of this approach should be looked into at school and university levels.

The Ministry of National Education (MoNE) in Turkey, which took action in 2016 to design the curricula in accordance with STEM education goals, announced that the learning outcomes in STEM-based education could be selected from among those specified by the Head Council of Education and Morality (Talim ve Terbiye Kurulu Başkanlığı-TTKB) and belonging to elective courses such as Environmental Education, Media Literacy, Creative Thinking, Scientific Applications, Mathematical Applications, Graphic Design (Integrated Teaching Project, 2016).

Overall, in STEM education, the connection between real life and the course content is established and the disciplines of science, mathematics, technology and engineering are aimed to be integrated (Yamak, Bulut & Dündar, 2014). According to Çorlu (2014), it is essential to develop research-based STEM strategies in our schools to foster cooperation among mathematics, sciences and technology and design teachers and to promote students' critical and creative thinking skills. STEM activities provides students with an opportunity to learn actively (Bransford, Brown & Cocking, 2000). A significant aspect of STEM education is that it has been integrated in such a way that the focus is on the real life applications of the fields of science, technology, engineering and mathematics and their approach in dealing with the complicated problems emerging in daily lives rather than teaching each discipline separately (Johnson, 2013; Roehrig, Moore, Wang, & Park, 2012; Bybee, 2010).

Another advantage of a STEM-based education is stated as students' seeking ways of solving problems using their existing knowledge when they encounter an unfamiliar situation (Wang, 2012). Previous research claimed that teachers' beliefs and attitudes about mathematics and sciences have had an impact on their classroom applications (Handal & Herrington, 2003; Levitt, 2002; Roehrig & Luft, 2004; Stipek, Givvin, Salmon, & MacGyvers, 2001; Wilkins & Ma, 2003). Morrison (2006) stated that individuals who have received STEM training are problem solvers, innovative, creative, self-confident, able to think logically, technology literate, and can connect their own culture and history with education. Similarly, Bybee (2010) defined these individuals as adaptable, self-controlled individuals with high decision making, communication, problem solving and social skills.

The number of studies on STEM in Turkey has been increasing notably in the past few years (Baran, Canbazoğlu-Bilici, & Mesutoğlu, 2015; Karahan, Canbazoglu Bilici & Ünal, 2014; Şahin, Ayar, & Adıgüzel, 2014; Yamak, Bulut, & Dündar, 2014).

The number of studies investigating teachers' views on STEM-based activities is quite few (Siew, Amir, & Chong, 2015; Wang, Moore, Roehrig, & Park, 2011). Sümen and Çalışıcı (2016) taught the environmental literacy course with STEM activities and took teachers' opinions. According to the results of the research, it was determined that teachers think these activities are effective, easy and fun. Çınar, Pırasa, and Sadoğlu (2016) investigated the pre-service science and mathematics teachers' views on STEM education, and according to the findings, prospective teachers stated that STEM applications are fun, improve psycho-motor and spatial skills, support cooperative learning, provide effective and cooperative learning. In another study Özbilen (2018) conducted with 5 science and a mathematics teacher defined the STEM education model as one of the indispensable building blocks of science and mathematics, but stated that they were reluctant to apply it due to reasons such as teacher competencies, materials and lack of cooperation.

In order to determine the deficienencies of teacher candidates towards STEM and STEM education, first of all, their perceptions should be revealed. Determining teachers' attitudes and perceptions about STEM is important for them to make up for their deficiencies on these issues (Morrison, 2006; Harris, Lowery-Moore ve Farrow, 2008).Teachers who have received the essential education about STEM and are proficient at it play a crucial role in making STEM education extensive throughout the world (Wang, 2012).

This study has been conducted to investigate mathematics teacher candidates' views on STEM education and the activities that they design. In this study, answers to the following questions were sought:

1. What are the opinions of mathematics teacher candidates on STEM education?
2. How are the activities to be used in STEM education, which are designed by mathematics teacher candidates ?

Method

Research Model

The study is handled with the "comparative case study" design, one of the qualitative research approaches. By dealing with more than one limited case, this study aims to analyse candidate mathematics teachers' views on STEM and the activities that they designed in comparison to each other as well as on their own. To this end, comparative case study, which encompasses the analysis of more than one case, has been employed. A case study analysing multi-cases (at least two) comparatively is called as a comparative case study (Stake, 2006).

Participants

Table 1. The Procedures of the Education

Week	Procedures	Content
1	The introduction of STEM as a notion	Students were presented some introductory information about the interdisciplinary nature of STEM (science, technology, engineering and mathematics)
2	The science aspect of STEM	The science aspect of STEM was introduced. The participants were given explanatory information on the science aspect of STEM.
3	The technological aspect of STEM	The technological aspect of STEM was introduced. The participants were given explanatory information on the technology aspect of STEM. Also, programs in which technology is used were introduced.
4	The engineering aspect of STEM	The engineering aspect of STEM was introduced. The participants were given explanatory information on the engineering aspect of STEM.
5	The mathematical aspect of STEM	The mathematical aspect of STEM was introduced. The participants were given explanatory information on the mathematical aspect of STEM.
6	An analysis of STEM-based activities	Sample STEM-based activities were analysed.. These activities were evaluated.
7	The design of STEM-based activities	Students were asked to design STEM-based activities. The missing and/or faulty parts in these activities were spotted and analysed by the researcher and the participants were given feedback on them.
8	An evaluation of the STEM-based activities	In that week, the researcher conducted interviews.

This study has been conducted with 34 senior mathematics education students in total. When determining the participants, appropriate sampling, which is one of the purposeful sampling methods, was used. Purposeful sampling method is determining a small group as a sample group in a way that will make gathering data easier (McMillan & Schumacher, 2014). The interviews were conducted with six volunteers.

The main objective of this study is to analyse the STEM activities devised by candidate teachers who have received STEM education. To this end, STEM education was given to candidate teachers in two classroom hours a week in a period of eight weeks. The procedures of the education given to candidate teachers is given in Table 1.

Data Collection Tools

The data of this study were collected in two stages.. In the first stage, activity cards were used. The activities designed by candidate teachers were analysed by using activity cards. In the second stage, interviews were conducted with volunteer candidate teachers by using semi-structured interview forms. The semi-structured interview form was prepared by benefiting from the body of literature. The prepared form was given to two experts in the field, which had their PhDs in the field of mathematics education and the experts were requested to evaluate the appropriateness of the questions in the form. According to the feedback received from them, some minor corrections were made and the form was given to three candidate mathematics teachers to check its language validity. The participants were asked the questions *"What do you think of the STEM education that you have received? Can you evaluate it?", "What do you think about the applicability of STEM education in secondary schools?", "Can you design activities suitable for STEM? What are the principles that you will take into account when designing these activities?", "What are the student skills that are fostered in STEM education?" and "Do you have some additional remarks on STEM education?".* According to the feedback obtained from teacher candidates, some additional questions were added to the form and it was revised to its final form.

To evaluate the candidate teachers' activities, an activity card was used. An activity card is a tool employed when evaluating the performance of participants. On the activity card, the statement "Design a STEM activity to enable fractions outcome which is in the curriculum of the fifth graders." was written.

Data Analysis

The data obtained in the study was analysed using the content analysis method. First, the obtained data was transcribed. Next, the transcripts were coded. Then, categories were formed by classifying codes according to their common features. The same process was followed both in the analysis of the interview form and the activity card. Coding was done by the first researcher and the codes were marked as "appropriate" or "inappropriate" by the field expert.

Validity and Reliability

The validity of the study has been dealt with as external validity and internal validity. To provide internal validity, the codes and categories are defined in detail. The most frequently used method to reflect the accuracy of the results obtained in content analysis is to include "direct quotes". To reach external validity, the research process has been explained and presented in a detailed way. Moreover, the theoretical framework is discussed in a detailed way in the introduction, and in the discussion section, the findings of this study is compared to those of the previously mentioned studies.

Reliability in content analysis especially depends on the coding process. If the category determination process is carried out meticulously, it is highly likely to perform a highly reliable study (Tavsancıl and Aslan, 2001). The interviews, after being transcribed, are based on the responses given to the interview questions by the researcher and an expert evaluation has been made. Evaluation was determined as "common opinion" and "difference of opinion". Reliability = common opinion/ (common opinion + difference of opinion) x 100 "calculated using(Miles & Huberman, 1994). Using this formula, the percentage of agreement was calculated as 0.82. Since this value is above 70%, it indicates that the coding made is reliable (Yıldırım & Şimşek, 2003).

Findings

Findings on Students' Views on STEM Approach

In this section, the findings obtained from the analysis of the students' views on STEM are presented in the form of tables by using content analysis.
In Table 1, the students' views on STEM approach are given. The findings in Table 2 are grouped under the category of "advantages."

Table 2. Students' Views on the STEM Approach, which they had a Training on

Category	Code	Frequency
	Beneficial	6
	Leading students to do research	3
	Encouraging group work	3
	Enabling to make interdisciplinary connections	2
	Teaching robotic coding	2
	Student-centered	2
	Enabling permanent learning	2
Advantage	Fostering creative thinking	2
	Integrative	1
	Enabling a good understanding of the subject	1
	Arousing interest	1
	Addressing kinaesthetic	1

	intelligence	
	Increasing work force	1
	Necessary	1
	Saving time	1
	Fostering inventive skills	1

As seen in the advantages category in Table 2, students mostly amphasized the idea that STEM approach is beneficial.

A student who thinks that STEM approach is beneficial expresses his views as follows:

"In terms of education, I think it is really beneficial because we are trying to teach multidisciplines all together. This enables us to give students more information in shorter period of time. Also, going to the Center of Science and Art and meeting robots there, and realizing that we can mobilize robots with just simple software affected me in a positive way."

A student who is of the opinion that the STEM approach will lead students to do research expresses his thoughts as in the following quotation:

"I mean, as we are not inclined to research, we don't do much research. That's why we can lead students to do more research with this method."

A student who holds the view that the STEM approach leads people to creative thinking expresses himself as follows:

"Because we are trying to synthesize mathematics, engineering and sciences in this approach, I think it will lead students to think differently and creatively. In that way, different points of view may emerge."

The views of a student thinking that the STEM approach will contribute to the development of kinaesthetic intelligence in students are as follows:

"This will improve students" kinaesthetic intelligence. If kinaesthetics is followed by verbal expressions and visual application, the student will be a gainer in every sense. In this way, multiple intelligence will be triggered and as it addresses various types of intelligence, everybody can benefit from it."

As can be seen in Table 3, the student views on the applicability of the STEM approach in secondary schools can be categorized under two headings: applicable and non-applicable. Students thinking that it is applicable hold the view that implementing the STEM approach in secondary schools is beneficial as it increases permanent learning.

Table 3. Student Views on the Applicability of the STEM Approach in Secondary Schools

Category	Code	Frequency
Applicable	Increasing permanent learning	4
	Leading students to do research	3
	Enabling students to think differently (creatively)	3
	Enabling students to make connections between disciplines	2
	Arousing curiosity	1
Non-applicable	Difficult to apply in crowded classes	1

Below are the views of a student thinking that the implementation of the STEM approach in secondary schools will enhance permanent learning:

"I think it's applicable. If it is integrated into subjects within a process, it can be applied quite well. Because it increases students"permanent learning. As it addresses more than one sense of the student, it is more permanent."

A student who expressed a negative view on the applicability of the STEM approach in schools, however, explains his opinion as follows:

"Overall, I don't think it is applicable to the curriculum in secondary schools. At high schools, skills are more differentiated but in secondary schools, there is no such differentiation yet, so I don't think it's applicable. Not all students can learn advanced mathematics. This is more like leading everyone forcibly to a high level of the numeric fields. Every student can learn information that is enough for himself but they shouldn't be pushed to advanced levels. Apart from this, it is difficult to apply it in crowded classrooms. Since STEM relies on application, I don't know how efficient it can be to apply it in crowded classes."

Table 4. Student's Views on Whether They Can Design Activities Suitable for the STEM Approach

Category	Code	Frequency
I can design it.	Suitable learning outcome	6
	Immediate circle	1
	Observation	1
	Daily life problems	1
	Interesting	1

As can be seen in Table 4, candidate teachers' views on whether they can design an activity suitable for the STEM approach are categorized under the heading "I can design it." Most of the candidate teachers state that they can design an activity to achieve a suitable learning outcome.

Below is a quotation clarifying the views of a student who thinks he can design an activity to reach an appropriate learning outcome.

> *"I think I can design one. I would be careful to use it for suitable learning outcomes. I would pay attention to not forcing it on students. I mean, I wouldn't say I will adapt every subject to technology or to engineering. If it would be a forced attempt, I wouldn't try to cover that objective. I would prepare an activity to concretize [the subject]. As one of the aims of STEM is to prepare the student for the daily life, I would concretize."*

Table 5. Student Views on the Skills Considered to Be Improved by the STEM Approach

Category	Code	Frequency
Skill	Motivation	5
	Knowledge	4
	Cognitive ability	2

As can be seen in Table 5, teacher candidates hold the opinion that the STEM approach improves motivation (46%), knowledge (36%) and cognitive ability (18%).

The opinions of a student who thinks that the STEM approach increases both knowledge and the motivation of the students expresses his thoughts as follows:

> *"It would increase their knowledge because they do research. It would help them explore their areas of interest. Because they browse their motivation would increase. There wouldn't be such thing as boredom. Because there is a lot to do research on. It would enable them to think and to improve themselves. As we will be the ones to design the STEM curriculum they may invent something without being aware of it."*

Below are the statements made by a student who is of the opinion that the STEM approach will increase students' motivation as well as improve their cognitive skills:

> *"It will increase motivation. Because the student will participate in the lesson more actively... Whether it is right or wrong, he participates in some way and as the teacher supports him, his motivation increases. As the student forms his own knowledge system about concepts, we can say that there is an improvement in both language [skills] and cognitive development. Because the student forms his own dictionary of concepts in his mind. Forming his own knowledge system about concepts... I mean the student reaches the concept by himself and that's why he systematizes the information that is required to be conveyed to him.*

Table 6. Student Suggestions to the STEM Approach

Category	Code	Frequency
	Informing teachers (Seminars)	2
	Courses to be offered at faculties	2
	A platform of sharing information	1
	Technological facilities	1
	Visual application	1

As can be seen in Table 6, 2 students (%29) suggested seminars about the STEM approach and 2 students (%29) suggested teaching it as a course at faculties.. One student said that a platform to share information is essential, one student stated that to maket he STEM approach a more effective one, technological facilities need to be increased and one other student suggested placing emphasis on visual applications.

The views of the student who helds the opinion that it is necessary to organize seminars about the STEM approach and to found a platform to share information on are as follows:

> *"If teachers are made more knowledgeable about STEM, if more seminars are given, if more emphasis is given on this subject at faculties of education, better outcomes can be achieved. A platform like EBA can be prepared on the internet, too. I mean, in terms of sharing of the samples with everyone, a teacher can design an activity about STEM and other teachers may contribute to it and enrich it. That is, a sharing platform can be established."*

Findings Related to Student Activities that are Prepared based on the STEM Approach

When the STEM-based activities of the mathematics teacher candidates are analysed, four categories emerge: the interdisciplinary link, the engineering field it is linked to, the preferred method and the activity not suitable for STEM. The codes reached under the theme interdisciplinary link and the activity visions of some of the teachers are presented in Table 7.

Table 7. The Codes Reached under the Theme of Interdisciplinary Link

Category	**Code**	**f**
The type of the interdiscipliny link	Science-Mathematics	5
	Engineering-Mathematics	1
	Mathematics-Technology	4
	Mathematics-Engineering	1

Table 7 indicates that the activities prepared by 5 of the candidate teachers (46%) cover the link between science and mathematics. Activities prepared by 4 candidate teachers (36%) deal with the relationship between engineering and technology. While the activity of 1 candidate teacher (9%) involve the relationship among engineering, mathematics and technology, the one prepared by the other candidate (9%) is about the connection between mathematics and engineering.

Table 8 below shows the codes reached in the category of the linked engineering field and the activity visions of some of the candidate teachers.

Table 8. The Codes Reached in the Category of the Linked Engineering Field

Category	Code	f
The linked engineering field	Geological Engineering	1
	Electrical Engineering	1
	Civil Engineering	2

As can be seen in Table 8, while two candidate teachers linked the activities they prepared to civil engineering, one of them linked it to geological engineering and another one linked it to electrical engineering.

The codes reached under the category of the preferred method and the activity visions of some of the teachers are given below in Table 9.

Table 9. The Codes Reached under the Category of the Preferred Method

Category	Code	f
The preferred method	Modelling	5
	Inquiry	1
	Game	2
	Presentation	1
	Question& Answer	1
	Invention	3
	Constructive approach	1
	Creative drama	2
	Material use	4

As can be seen in Table 9, 5 of the the participant candidate teachers (25%) used modelling in the STEM-based activities they designed. 4 of them (20%) designed activities based on material use 3 of the candidates (15%) designed activities using the method of invention. 2 of the candidate teachers (10%) designed an activity using creative drama. 2 of the candidate teachers designed the activity (10%) with a game. One of them (5%) designed it with the inquiry technique.. One of the candidates (5%) designed the activity with the presentation technique. One of the candidate teachers (5%) designed it using the question and answer technique. 1 of the candidate teachers (5%) designed it adopting the constructive approach.

The codes reached under the category of activities not suitable for STEM and the activity visions of some of the teacher candidates are given in Table 10.

Table 10. The Codes Reached under the Category of Activities Unsuitable for STEM

Category	Code	f
Activity unsuitable for STEM	Interdisciplinary link	2
	Low feasibility	6
	Knowledge-based Real-Life Problem	2
	Product	2
	Evaluation	1

Table 10 shows that 13 of the candidate mathematics teachers who participated in the study prepared an activity that is not suitable for the STEM approach. Six of the teacher candidates (46%) designed activities with low feasibility. The activities designed by two teachers did not cover a knowledge-based real life problem. Two of the candidates designed their activities without sticking to the principle of making a connection between disciplines. In two of the activities designed by candidate teachers, there was no production.. One other activity prepared by a candidate lacked an evaluation.

Conclusion and Discussion

The majority of the candidate mathematics teachers who participated in this study, which aims to investigate their views on STEM education and the STEM activities that they designed, expressed positive views on STEM education. The body of literature also supports the findings of this study (Eroğlu & Bektaş, 2016; Siew, Amir & Chong, 2015; Wang, 2012; Wang, Moore, Roehrig & Park, 2011).

Except for one of the teacher candidates, all of them expressed positive views on the applicability of STEM education in secondary schools. In Wayne Long's study (2012), it is argued that it is essential to give STEM education in primary and secondary schools. Similarly, Huneycutt (2013) and Yıldırım and Selvi (2013) state that it will be beneficial to give STEM education at an early age. Weyrick (2010) contends that giving STEM education in every phase of the educational process will provide the students with the opportunities to acquire such skills as cooperative learning, critical thinking, interpersonal communication skills, which are regarded as 21st century skills and engineering skills. It is also argued that STEM education facilitates students' acquisition of 21st century skills such as the ability to solve complex problems, communication and cooperation, the importance of which are increasing day by day (Bybee, 2010).

Most of the candidate teachers stated that they could design activities suitable for STEM to reach the desired learning outcomes. A good STEM lesson not only covers the subject previously taught by the teacher but also must be connected to other subjects. This enables the teacher to teach the STEM integration more effectively and makes them more enthusiastic about the application of STEM integration in their classes.

The skill that the candidate teachers think the STEM approach improves the most is motivation. Most of them also hold the opinion that the STEM approach increases knowledge and improves cognitive skills. The findings of this study on this subjecet are supported by the body of literature. In their study aiming to investigate teachers' and candidate teachers' views on the use of STEM approach in science classes, Siew, Amir and Chong (2015) state that the participants thought a project-based STEM approach contributed to an increase in students' interest and motivation in science classes after a 8-week workshop held for them. Furthermore, teachers and candidate teachers expressed their view that due to the applications done, STEM education improves scientific process skills. Likewise, Eroğlu and Bektaş (2016) investigated the opinions of the science teachers, who received a

STEM education, about STEM-based classroom activities and this study found that science teachers thought STEM and STEM-based activities contributed to an increase in student motivation and interest in addition to improving their scientific process skills. Another study investigating the effect of science-technology-engineering and mathematics activities on the fifth graders' scientific process skills and their attitudes to science, which was carried out by Yamak, Bulut and Dündar (2014), concluded that students' mental and cognitive skills improve as they employ the skills of observation, experiment design and determination of the variables in mini-design applications.

When the findings about candidate teachers' suggestions on the STEM approach are analyzed, it is seen that some teacher candidates suggested seminars about the STEM approach, while some others underlined the necessity of introducing the STEM approach in courses at faculties. In their study, Aslan-Tutak, Akaygün and Tezsezen (2017) introduced a Cooperative STEM Education Module, which was prepared according to the STEM Education Approach and they did research into the effects of the module on the candidate teachers' perceptions of STEM education. When asked what kind of a support as regards STEM they would like to be given, the participants responded by saying that they needed to observe sample projects and attend seminars. On the other hand, for the integration of the holistic and interdisciplinary outlook brought about by the STEM education into Turkey's educational system, it is necessary to raise the awareness of teachers, who are one of the main pillars of the educational system, on STEM when they are studying at the faculty of education (Buyruk and Korkmaz, 2016)

The first category obtained through the analysis of the activities designed by teacher candidates is the type of the interdisciplinary link. When the activities designed by the candidate teachers are analyzed, it can be seen that they mostly prepared activities based on the relationship between science and mathematics. In the model presented by Çorlu et al. (2014) on STEM education, mathematics and science have central roles, whereas the fields of engineering and technology are restricted to supportive roles. The same number of teacher candidates, on the other hand, prepared activities focusing on the relationship between mathematics and technology. Only one of the students prepared an activity using the link among mathematics, engineering and technology.

Another code reached through the activities designed by teacher candidates is the linked engineering field. Under the category of the linked engineering field are the codes of civil engineering, electrical engineering and geological engineering.

Still another category obtained via the activities designed by candidate teachers is the preferred method. The teacher candidates used various menthods in the activities that they designed. The methods that were used most were modeling and material use.

The last category obtained through the activities designed by teacher candidates is activities unsuitable for the STEM approach. Most of the activities designed by candidate teachers have low feasibility. Some candidate teachers did not fulfill the requirement of covering a knowledge-based real-life problem, while some others did not make the interdisciplinary connection. In some other activities, on the other hand, there was not a product.

Considering the opinions of the teacher candidates participating in the study teacher candidates should be trained on how to integrate STEM education into their lessons and stem activity examples should be presented to teacher candidates for applicability.In future research, after analyzing the other studies in the body of literature, a survey can be prepared and a wider sample can be used. In this study, candidate teachers were asked to design an activity to teach mathematics. However, these activities can be designed for subjects other than mathematics.

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