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I. INTRODUCTION

The advances in science, and technology have gained great momentum in the 21st century especially affecting almost all areas of contemporary life. These advances have created some problems in the globalizing world, and the integration of science, technology, engineering, and mathematics disciplines has been required to solve these problems (Moore et al., 2014). As a natural result of integrating the aforementioned disciplines, the concept of STEM came to the agenda. STEM is a holistic concept that is the intersection of the disciplines it contains (Eroğlu and Bektaş, 2016). In the field of education, this intersection or integration of these disciplines has emerged from the initials of the words 'science', 'technology', 'engineering', and 'mathematics' in English - the concept of 'STEM education.' It has appeared as a new educational approach in the form of 'FeTeMM education' consisting of initials of the Turkish words for Science, Technology Engineering, and Mathematics. STEM education approach has been rapidly adopted in schools in both developed and developing countries and is rapidly becoming widespread. With the fast adoption of STEM education in schools, teachers and students can improve themselves in several areas (physical, cultural, social) and increase their self-efficacy towards gaining a critical structure and solving their problems more easily (Çorlu and Aydın, 2016). In addition, STEM education brings different disciplines together and provides multi-dimensional learning with an inter-disciplinary approach (Smith and Karr-Kidwell, 2000). As one of the answers to the question what is STEM education?, it can be briefly explained that STEM education enables students to blend interdisciplinary knowledge and integrate them to find solutions to the problems they face. It should also be remembered that preparing the future that the 21st-century economy has built will be realized with the solution-oriented learning

activities of students. In this context, the STEM education approach is important in gaining the 21st-century skills of students as individuals of the future (Aydeniz, 2017). Because it is very important for STEM education to raise qualified individuals to produce innovations that will provide an economic advantage for countries and keep up with what the era is bringing, and not fall behind the developments (Eroğlu and Bektaş, 2016).

It is seen that the aims of STEM education are compatible with these skills. These objectives can be broadly listed as follows (Thomas, 2014):

- To create a workforce consisting of people with STEM literacy.
- To continue the current operation in the field of STEM.
- To be able to produce innovations that will provide an economic advantage for countries.
- To be sufficient in future business areas.

As a vision of science education, the STEM education approach is important for science literacy (Miaoulis, 2009) to train experts and engineers who will interpret scientific and technological innovations. For this reason, STEM education should be integrated into the education system to develop the national economy and lead science and technology (Lacey and Wright, 2009). It is also known that receiving this integrated education at a young age has contributed to the orientation of individuals to these disciplines in the following years (National Research Council [NRC], 2011), and they have been able to apply what they have learned to the new situations they encounter (Morrison, 2006). Providing STEM education in schools and increasing the number of students who have received this education play an important role in gaining science literacy, achieving the future progress goals of countries in general, creating employment in industry, and increasing education. However, the realizing of qualified STEM education is related to the fact that teachers receive adequate and qualified STEM education (Wang, 2012). In this context, one of the important steps is to refer to the views of teachers on STEM education. As Wang (2012) stated, STEM education-based programs can make sense with qualified teachers, so it is important to determine what the situation is by referring to the opinions of teachers for qualified education.

When the literature is analyzed, it is seen that studies about STEM education are carried out in several countries. For example, in Turkey, it is seen that studies are conducted about STEM but remain limited in number (Baran, Canbazoğlu and Mesutoğlu, 2015; Karahan and Canbazoğlu 2014; Sahin, Ayar and Adıgüzel 2014; Yamak, Bulut and Dundar, 2014). Another point that draws attention among these studies of the countries is that the researches about how the STEM program should be shaped and how the teachers will implement the programs have been limited (Dugger, 2011). Likewise, it has been observed that the studies about STEM in the Turkish Republic of Northern Cyprus (TRNC) are very few, and the views of teachers who deliver science education about STEM, which is a current education approach, have not been examined.

This study, it is aimed to determine the views of teachers who give science education in TRNC about STEM education. For this purpose, answers to the following research question were sought.

- What are the opinions of teachers who give science education about STEM education?

II. METHOD

2.1 Research Model

The research was carried out using the case study pattern. A case study is defined as a method in which one or more events, environments, programs, social groups, or other interconnected systems are examined in depth (McMillan, 2000). The case study method was chosen to reveal in detail the opinions of teachers who deliver science education about science, technology, mathematics, and engineering (STEM). The case examined in the research is the opinions of teachers who deliver science education about integrating science, technology, mathematics, and engineering. In the study, the internal case study pattern, one of the case study patterns, was used. In this pattern, the situation itself is focused on

because the case is unusual or unique (Creswell, 2016). In the study, the realization of teaching by integrating science, technology, mathematics, and engineering has been determined as the case itself and has been handled as a whole.

2.2 Study Group

The universe of the research is the teachers who work in public and private primary schools in TRNC in the 2017-2018 academic year and provide science education. Due to the limited access to the universe group, a sample was selected using a convenience sampling method. The sample group consists of science education teachers of a private school chosen according to the convenience sampling method. Within the framework of the volunteering principle, ten teachers providing science education participated in the study and formed the sample group. Information on the demographic characteristics of the teachers participating in the research is given in Table 1.

Table 1: Demographic characteristics of teachers participating in the research

Independent variables	Groups	f	%
Gender	Female	6	%60
	Male	4	%40
Age	21-30	5	%50
	31-40	3	%30
	41-50	2	%20
Seniority	0-5	4	%40
	6-10	3	%30
	11-15	3	%30
Education Status	Undergraduate	7	%70
	Master	3	%30

Of the 10 participants who participated in the study, 6 (60%) were women, and 4 (40%) were men. Also, 5 (50%) of the teachers who constitute the study group of the research are between the ages of 21-30, 3 (30%) are between the ages of 31-40, and 2 (20%) are between the ages of 41-50. Four participants (40%) have 0-5 years of professional experience, 3 (30%) have 6-10 years of professional experience, and 3 (30%) have 11-15 years of professional experience. It can be said that most of the teachers participating in the research are new graduates. Seven (70%) of the teachers delivering science education who participated in the research have undergraduate education, and 3 (30%) have graduate education.

2.3 Data Collection Tools

In the research, STEM Education Interview Form was used to determine the opinions of teachers about STEM education who delivered science education. The STEM Education Interview Form used in the research was prepared by Yıldırım (2017). During the preparation phase, a review was done by a faculty member and two research assistants to check the extent to which the purposefulness, comprehensibility, and applicability of the STEM Education Interview Form. As a result of the feedback of these academicians a form was arranged. A form consisting of 10 problems was obtained by implementing a pilot application with three teachers who provided science education.

2.4 Collection of Data

Interviews were conducted with teachers using the interview form to obtain their views on STEM education. In this context, questions that teachers have on their minds, if any, were answered by the

researchers before to the interview. Before starting the interviews, an interview protocol was read to the teachers, and a voice recorder was used with the permission of the interviewed teachers to prevent possible loss of data in the recording of their data. In addition, the note-taking technique was used where necessary. During the interviews, which lasted for an average of 40 minutes, all participants were allowed the use of voice recorders.

For the interviews to be held with the teachers who delivered science education, the interview hours were determined beforehand. The interviews were held face-to-face in a quiet room at the school where the researchers conducted the study. The teachers were informed in advance about the meeting to be held. The teachers interviewed were selected according to the principle of volunteering.

2.5 Analysis of Data

Findings obtained from semi-structured interviews with teachers providing science education were subjected to content analysis.

In content analysis, which aims to teach the concepts and relationships that can explain the collected data, the similarities of the data are determined and brought together within the framework of certain concepts and themes. In the coding phase, which is the first stage of content analysis, the data obtained are examined, tried to divide into meaningful sections, and what each section expresses conceptually is determined. After the codes are identified, the themes that can collect the codes under certain categories should be determined (Yıldırım & Şimşek, 2016). Categories are conceptual elements that cover several unique examples and relate to each other. Some of the basic categories can become sub-categories during content analysis. The names of the created categories can be based on the researcher, participant or literature (Merriam, 2015). These stages were followed in the content analysis conducted in this research.

Before analyzing the qualitative data obtained from the research, semi-structured interview data was transcribed first. The transcripted interview texts were presented to the teachers interviewed. The necessary changes were made on the interview text by asking whether the data in the transcript reflected their views and whether there is anything they wanted to add (confirmation of the participant). In addition, during the presentation of the transcripts of the interviews, the questions regarding the answers that were not clearly understood / comprehended by the researcher during the interviews with the teachers were asked once again. The data obtained from the interviews were tried to be validated. Codes, categories, and in some questions, sub-categories were created for each question by evaluating the opinions of the teachers. The data obtained from the interviews were then digitized by making them expressible as frequencies. Digitization was made to perform comparison between categories (Yıldırım & Şimşek, 2016). Findings from the interview data are presented in tables and interpreted.

Names of persons are not given in the text considering ethical factors in presentating the interview data (Ford & Reutter, 1990). Direct quotations of the answers of the teachers selected from the scale participants and coded as Ö1, Ö2, Ö3, Ö4, Ö5, Ö6, Ö7, Ö8, Ö9, Ö10 are included.

2.6 Validity and Reliability

In this study, the strategies proposed by Erlandson, Harris, Skipper and Allen, 1993 (cited in Yıldırım & Şimşek, 2016) were used to minimize or eliminate factors that affect/threaten validity and reliability.

First of all, to increase the internal validity (credibility) of the study, as the negotiation time progressed, the time limit was not restricted in order to ensure a trusting environment and more sincere answers, and a long-term interaction was attempted. In addition, to obtain stronger data from the same teachers to reflect the truth, a contribution was made to the long-term interaction by conducting interviews for the necessary questions (long-term interaction). On the other hand, the results obtained from the interviews were supported by the findings obtained from other studies in the literature, and

effort was paid to increase the credibility of the research. As another measure taken within the scope of internal validity, expert opinions were used during the preparation of interview questions, analysis of the data and, the study process (expert review). In addition, the transcripts obtained from the interviews were checked by the interviewed teachers, and corrections were made where necessary (confirmation). Furthermore, within the scope of external validity (transferability), direct quotations are included (detailed description) to enable the data to be described in more detail.

To increase the internal reliability (consistency) of the study, questions were asked in the collection of data based on the interview form and using a voice recorder with a similar approach. In addition, the categories and codes obtained from the interviews were checked twice by the researchers one week apart.

Miles and Huberman (1994) refer to converging codes as 'Agreement' and diverging codes as 'Disagreement' and suggest the formula of Agreement Percentage = Agreement / (Agreement + Disagreement) * 100 for coding reliability. The fact that Miles-Huberman reliability formula value is above 70% shows that their coding is reliable (Akay and Ültanır, 2010). The coders' consideration of sub-problems and their orientation towards theme-oriented coding increased the 'percentage of agreement between coders. In qualitative data analysis, the level of cohesion between encoders is evaluated as an indicator of coding reliability. Therefore, it was interpreted as a high level of agreement among coders. Converging codes in the study are identified as 89, diverging codes were identified as 22, and agreement percentage was found as 80%. The percentage of agreement above 70% indicates that there is a high level of consensus among coders.

III. FINDINGS

3.1 Findings Related to the Views of Teachers Regarding STEM Education Providing Science Education

3.1.1 The relationship between science course and technology and mathematics

In the first question of the interview, the following question was asked to the teachers: "Is there a relationship between science lessons and mathematics and technology? If there is a relationship, what is it?" The categories and codes created according to the answers obtained are shown in Table 2.

Table 2: Teachers' thoughts on Science's relationship with Technology and Mathematics

The relationship between science and Technology and Mathematics	Frequency
Integrity with each other	9
Using Mathematics and Technology in question solutions / operations	6
Using Mathematics and Technology in experiments	4
Contributing to his learning	3
Learning by doing and living	2
Embody what has been learned	2

All the teachers interviewed underlined the relationship between science, technology, and mathematics. As can be seen in Table 2, the majority of teachers (f: 9) stated that science and technology and mathematics are integrated.

The teacher named Ö1 expressed his thoughts as follows: *"There is a connection between each other... Speed problems in science come to my mind. For example, it is necessary to multiply speed and time to calculate the distance a vehicle travels at a certain time. We need to do*

mathematical operations to do this operation. I think the same is true in the relationship between science and technology. We have several technologies that we use in our daily lives, such as internet-connected smart boards, mobile phones, tablets, and computers in the classroom. These technologies have taken their current form thanks to the science of mathematics. So, these three concepts are interconnected".

The teacher with the code Ö10 put forward his thoughts as follows: "*Of course there is. Today, technology and all disciplines should be combined and given in integrity. In science lessons, mathematical data is often used when expressing experimental results. Using technology, both lessons can be taught, and students can do research using technology and access information in an easy way*".

The Ö3 coded teacher put forward his opinions as follows: "*Of course there is a relationship, science is already a lesson in our lives, it is an integral part of our lives. For example, even technological tools and equipment such as microscopes, telescopes, magnifiers that we use in experiments are designed according to the rules of physics and mathematics, and work according to the information there.... To solve a problem in physics-related issues in science, we need mathematics, so they are intertwined*".

The teacher named Ö4 expressed his thoughts as follows: "*All three are interrelated. Because to comprehend science, mathematical operations must be known, and mathematics and science are used to reveal something new in technology".*

3.1.2 Opinions of teachers on engineering skills

In the second question of the interview, the teachers were asked the question "What do you think about engineering skills? Have you ever heard of this concept?" and the categories and codes created according to the answers obtained are shown in Table 3.

Table 3: Teachers' thoughts on Engineering skills

Thoughts on Engineering skills	Frequency
Design	10
Improving psychomotor skills	8
Product reveal	7
Making an Invention (Creating an Original Invention)	7
Improving your imagination	5
Revealing creativity skills	4
Improving problem-solving skills	4
Developing critical thinking skills	3
Uncovering digital intelligence	2
Using Technology effectively	2
Measuring	1
Require experimental material knowledge	1

As shown in Table 3, the thoughts about engineering skills of all teachers (f: 10) were gathered under the category of 'designing'. In addition, most of the teachers stated that their engineering skills improve the psychomotor skills of students (f: 8), that they provide students with the opportunity to produce products (f: 7) and make inventions (f: 7). Half of the teachers stated that their engineering skills improved the imagination of students. In addition, teachers found that engineering skills reveal students' creativity (f: 4), problem-solving (f: 4) and critical

thinking (f: 3) skills, reveal their numerical intelligence (f: 2), and their ability to use technology effectively (f: 2), and stated that it allows them to make measurements (f: 1) and that they should have knowledge about experimental materials (f: 1). Sample quotations from the answers obtained from the second question of the interview are given below.

'Engineering is a profession that requires talent. Psychomotor skills and numerical intelligence should also be prioritized in this profession. If there is no talent, they cannot be a successful engineer. '(Ö2)

'Engineering skills are the ability to think like an engineer. In science courses, especially students who want to choose the engineering profession in the future should be taught. I have not heard of this concept in my professional life before, but I have heard it during my graduate studies. '(S5)

3.1.3 Gaining engineering and design skills in science class

In the third question of the interview, the following question was asked to the teachers: "Can science and engineering skills be taught in the science course? How can this be achieved if it can be gained?" The data obtained from the third question of the interview are given in Table 4.

Table 4: Teachers' thoughts on whether Engineering and design skills can be gained during Science lesson teaching process

To gain Engineering skills in Science class	Frequency
May gain	9
In activities related to experiment and material design	8
With the realization of teaching by doing and living	7
In teaching situations where creativity is at the forefront	5
In experiments requiring group work	3
By doing projects related to students' daily lives	3
By making more use of Technology in the teaching process	2
Paying attention to individual differences in teaching	2
Be endowed	3
The low accessibility and implementation in schools with low economic level	2
Due to the realization of subject-centered education	1
Teachers' inadequacies on this subject	1

As can be seen in Table 4, the majority of teachers stated different reasons and said that they thought that their engineering skills could be gained during the science lesson teaching process. Teachers argued that students could gain engineering skills by conducting activities related to experimental and material design (8 teachers), realizing teaching by doing-living (7 teachers), and in teaching situations where creativity was at the forefront (5 teachers). On the other hand, 3 of the teachers argued that their engineering skills could not be transferred to students because of the difficulty of transferring engineering skills to students in schools with low economic levels (2 teachers), the realization of subject-centered teaching (1 teacher), and the teachers' inability to

transfer engineering skills to students (1 teacher). Sample quotations from the answers obtained from the third question of the interview are given below.

"Today, students need to be developed most in these areas because if they are creative, they will be very successful in their future lives. Currently, students are often presented with ready-made materials, and they are not required to make their designs. Unfortunately, children are accustomed to it, become free-riders, and get lazier. The main needs of children are activities that develop their creativity and imagination. It is both more enjoyable and more useful. I think that if this training is given from the ground up, with emphasis on imagination and creativity, that is, if some things are created from the ground, engineering and design skills will improve." (Ö4)

"It is very useful if it is earned. Engineering is already built on design. Unfortunately we do not want to do it, but it is teaching by heart. In my opinion, if we perform a teaching in which students can use their imaginations, useful things can arise. Activities for developing materials should be increased in science class."(Ö2)

"It can be transferred. However, first of all, it is necessary to eliminate the problem of lack of tools and materials in schools and to design an integrated program. What I mean by integrated is a program design in which discipline fields can be combined. For example, even a student designing a project in a science lesson can be effective in gaining these skills. Therefore, science lessons are very suitable for these skills." (Ö9)

3.1.4 Realization of an education where science, technology, mathematics, and engineering are found together

In the fourth question of the interview, the following question was asked to the teachers: "Can an education with science, technology, mathematics and engineering take place? If yes, can you give an example of this?" The categories and codes created according to the answers obtained are given in Table 5 below.

Table 5: Teachers' thoughts about teaching, including Science, Technology, Mathematics and Engineering.

The realization of teaching that includes Science, Technology, Mathematics, and Engineering together	Frequency
Realizable	
Students make the designs in the activities	8
Increasing imaginative activities	7
Active involvement of students	6
Enabling students to find solutions to the problems they encounter in daily life	6
Students developing materials in the course	4
Teachers actively use Technology	3
Difficult to perform	2
Insufficient lesson hours	5
Teachers inadequate in Technology	4
Teachers tend to prefer easy ways of teaching	4
Teachers with high age levels have a particularly closed attitude towards innovations.	3
	2

As shown in Table 5, eight of the teachers stated that teaching involving science, technology, mathematics, and engineering could be carried out. In contrast, five stated that it was difficult to deliver such teaching. Teachers argued that science teaching based on science, technology, mathematics, and engineering would be carried out by the students making the designs in the activities (7 teachers), increasing their imaginative activities (6 teachers), and realizing the teaching by providing active participation (6 teachers). On the other hand, teachers argued that it is difficult to carry out such a science education in our current education system due to the insufficient lesson hours (4 teachers), the inadequacy of teachers regarding technology (4 teachers), and teachers' tendency to prefer easy ways in teaching (3 teachers). Sample quotations from the answers obtained from the fourth question of the interview are given below.

"It can be realized. I think it can be used in laboratory activities. For example, let's say we install a simple electrical circuit; when we give the student the opportunity to plan and design it, the engineering skills of the student come into play. But the aim here is not to give the student a ready circuit, but it should be the student's design. We often use mathematics when calculating problems. We already use technological tools in the whole process. In addition, while teaching, experiments can be done based on more imagination, the experiments can be left to students, and they can be products that students will reveal with their imagination rather than directly addressing the subject."(S8)

"If we think in terms of the curriculum, there will be a shortage of time in realizing such teaching. After all, there are topics to be covered in the curriculum within a 40-minute class hour. The teacher will have problems covering the topics and giving the students the time it takes to do the appropriate activities, or they will keep the time required for the activities in much less time. Students should be able to transfer what they see in science to technology, transfer what they learn in technology to mathematics, and support it in a way that is intertwined with each other." (C5)

"It can be realized. A science project can be considered. Students are given a problem and asked to find a solution. For example, they are asked to develop a tool that will make them easier to carry their bags as their bags are too heavy. First, the design phase of this tool includes engineering skills as it is; maybe it will need leverage from science lesson topics to design this tool. In addition, the student will have to perform certain calculations when making this design. Even this requires the four fields to be used together." (O9)

3.1.5 Science subjects that can be taught by interrelating science, technology, engineering, and mathematics

In the fifth question of the interview, the following question was asked to the teachers: 'If you were going to teach by integrating science, technology, engineering, and mathematics, what science subjects would you apply this method to? Why?" The categories and codes created according to the answers obtained are shown in Table 6 below.

Table 6: Teachers' thoughts on the state of teaching, including Science, Technology, Mathematic, and Engineering

Science subjects that Science, Technology, Engineering, and Mathematics will be applied about each other	Frequency
Physics	8
Simple Electric Circuits	7
Force and Motion	6
The pressure of Solid, Liquid, and Gases	5
Space and Solar System	4
Light and Sound	3

Biology	5
Living World	4
Systems in Our Body	3
The Circulatory System	2
Excretory System	1
Support and Motion System	1
Digestive System	1
Nervous System	1
Chemistry	4
Heat and Temperature	3
Particulate Structure of Matter	2
Pure Substances and Mixtures	1
Acids and Bases	1

As shown in Table 6, eight of the teachers suggested that within the scope of a science lessons, science, technology, mathematics, and engineering could be applied by associating them in the 'Physics'. They stated that within the category of physics subjects, this method could be applied for simple electrical circuits (7 teachers) and force and motion (6 teachers). On the other hand, teachers argued that teaching in subjects of science category could be carried out with an interdisciplinary approach in the subjects of 'biology' category (5 teachers). Finally, teachers stated that with the interdisciplinary approach, science teaching could be applied in subjects within the chemistry category (4 teachers). Sample quotations from the answers obtained from the fifth question of the interview are given below.

"I think these types of approaches can be used more in physics topics. I can apply it on biology issues after physics issues but, I don't think it can be adapted to chemistry too much because the physical facts are easier to shape and embody than in chemistry at the design stage. For example, it is easier to chart or symbolize an experiment in a physics class. I can apply this approach to simple electric circuits, especially in physics. Because in general, this subject contains all of mathematics, science, and engineering. I can make students take a simple level of measurement that measures the pulse in the circulatory system of biology, or I can ask them to embody it by creating a design that shows systemic circulation." (Ö6)

"İt applies to all topics; I do not want to limit myself. Any issue where real-life problems can be addressed requires a problem-solving process. The solution to this problem requires all four field skills. An idea, a solution proposal will surely arise in the solution of the problem. For this to occur, all four field skills are required in most cases." (Ö7)

3.1.6 Advantages of science teaching based on the integration of science, technology, mathematics, and engineering

In the sixth question of the interview, the following question was asked to the teachers: "Are there advantages of teaching by combining science, technology, mathematics, and engineering with an interdisciplinary approach? If so, explain what kind of advantages can science teaching have in this manner." The data generated according to the answers obtained from the sixth question are shown in Table 7.

Table 7: Advantages of Science teaching based on Science, Technology, Mathematics, and Engineering integration

Advantages of Science teaching based on Science, Technology, Mathematics, and Engineering integration	Frequency
Advantages for the student	10
Interest in Science and Technology lesson	8
The prefer to learn permanently	7
Supporting meaningful learning	7
Increasing academic success	6
The need for the development of mental, affective, and psychom skills	5
Increasing student's active participation	4
Being involved in cooperative learning	3
Goal setting / awareness	3
It will improve problem-solving skills	3
Improving communication skills	2
Review the development of critical thinking skills	2
Improving creativity	2
Improving your imagination	1
Improving self-confidence	1
Improving holistic thinking skills	1
Advantages for the teacher	4
Making teachers aware of their competencies	3
Creating opportunities for teachers' professional development	2
Making her love her job more	2
Enabling Technology to be intertwined	1
Advantages for our country	4
Increasing the quality of education	3
Training qualified staff	3
Technological developments increase	2
To train students more equipped	2
The development of the country's economy	2
Development of medical and Engineering fields	1
More productive student profile to go to university	1

All of the teachers stated that science teaching based on integrating science, technology, mathematics, and engineering would be advantageous. As seen in Table 7, the advantages of teaching based on the integration of science, technology, mathematics, and engineering are gathered under three categories: advantages for students, advantages for teachers, and advantages for our country. In terms of advantages for the students, the majority of teachers stated that it would ensure that students love science and technology lessons (8 teachers), and it would provide permanent and meaningful learning (7 teachers). It has been stated in the category of advantages of teaching based on science, technology, mathematics, and engineering integration that it would enable teachers to realize their competencies (3 teachers), provide teachers an opportunity for their professional development (2 teachers), and make them love their profession more (2 teachers). In the category of advantages for the country, the teachers mentioned that the quality of education would increase with the interdisciplinary science education (3 teachers), qualified staff would be trained (3 teachers), technological developments would increase (2

teachers), students would be educated more comprehensively (2 teachers), and the national economy would develop (2 teachers). Sample quotations from the answers obtained from the sixth question of the interview are given below. *"First, it will have a great contribution to the students on their critical thinking and problem-solving skills. Collaboration of the designs they will make in groups will enable students to learn from each other, i.e., through their peers. Apart from this, parallel to the preceding, individuals who can express themselves and have high communication skills and confidence will be raised. Students' problem-solving skills will improve, and their use in daily life will increase."*(Ö4)

"I think it will contribute to the students. Thus, I think that when students combine a holistic study with their knowledge intertwined in other fields, they will be more successful in science, as well as other related courses. In this way, I think these areas will complement each other's deficiencies. The information learned through collaborative and peered learning is much more permanent, meaningful and effective. With mutual communication and group work, students contribute to each other's learning by overcoming each other's shortcomings.." (Ö3)

"In this way, students both become aware of the problems around them and try to find solutions and start researching. Later, when the student starts researching, he will first investigate the problem around him and perhaps find a problem he has never paid attention to. Thus, he will develop his imagination and creativity while trying to find a suitable solution. Such an application can be beneficial if it is given from kindergarten where students start to develop themselves in every aspect in terms of science, mathematics, and design. In addition, while doing these, they also contribute to other courses and learn more meaningfully than memorizing what they have learned. Perspectives develop against the problems around them, and they try to find solutions. To give an example, when a child who drops litter into the environment develops a solution proposal for this issue, they will be more sensitive about dropping litter into the environment or will try to make the people around him more sensitive with the proposed solution." (Ö7)

"This may contribute to students' future career choices because the children at that age can be influenced by choice of the profession even from the movies they watch. If he likes to work with science, mathematics, and technology while developing materials, he can set himself a goal for his future, and this can be very effective in his professional development." (Ö1)

'There certainly is. Such an approach also gives the student integrated thinking skills. Thus, he can solve a problem he encounters much more quickly.' (Ö10)

3.1.7 Disadvantages of science teaching based on the integration of science, technology, mathematics, and engineering

In the seventh question of the interview, the following question was asked to the teachers: "Are there any disadvantages of teaching by combining science, technology, mathematics, and engineering with an interdisciplinary approach? If so, what kind of disadvantages can science teaching have in this way? Explain." The data generated according to the answers obtained from the seventh question are shown in Table 8.

Table 8: Difficulties in the implementation of Science teaching based on Science, Technology, Mathematics, and Engineering integration

Problems that may occur in the implementation of Science teaching based on Science, Technology, Mathematics, and Engineering integration	Frequency
Problems that may occur in practice	9
The problem of training enough teachers on this subject	8
Most middle-aged and older teachers may be reluctant	7
Time is limited	6
Budget/material deficiencies	6
Do not require extra responsibility for the teacher	5
Having difficulties in producing original products	4
The effectiveness of teachers on the subject affects the student profile	3

The vast majority of teachers stated that, regarding the seventh question, science teaching based on the integration of science, technology, mathematics, and engineering would not have a disadvantage. Still, there may be problems in its implementation (9 teachers). As shown in Table 8, most of the teachers mentioned in practice that there may be a problem of raising sufficient teachers in this regard for the problems that might arise in practice (8 teachers). He also stated that most middle-aged and older teachers would not want to improve in interdisciplinary science teaching (7 teachers). It was mentioned that time may be limited (6 teachers), and budget/material could be inadequate (6 teachers). Sample quotations from the answers obtained from the seventh question of the interview are given below.

'It would be nice if it is applied, but I think there will be some problems in the application. For example, in most of the schools I have worked, especially teachers over a certain age, are closed to innovations; they do not want to use technology. There are even teachers who still do not know how to use the smartboard. They are also not very prone to learning. I think that new generation teachers like us can deliver such teaching the best, but we may have difficulties in the first place because we have not received any training in this area before.' (Ö8)

'If the teacher who delivers this education does not have sufficient knowledge and skills on the subject, then students may be confused. This type of education requires real expertise.' (Ö7)

3.1.8 Whether or not teachers feel sufficient in the implementation of science teaching based on the integration f science, technology, mathematics, and engineering

In the eighth question of the interview, the following question was asked to the teachers: "Do you feel sufficient in designing the course, giving feedback to the students, and guiding the students in the science teaching process that includes science, technology, mathematics, and engineering? Why?" The data obtained from the eighth question is shown in Table 9.

Table 9: Whether teachers feel enough in the implementation of Science teaching based on the integration of Science, Technology, Mathematics, and Engineering

Whether teachers feel enough in the implementation of Science teaching based on the integration of Science, Technology, Mathematics, and Engineering	Frequency
Not feeling enough	10
Lack of practice in Science, Technology, Mathematics, and Engineering integration	8
Lack of trust in the use of Technology	7
Lack of self-confidence in designing	6
Lack of application due to lack of tools/materials	5
Feeling enough	2
Feeling sufficient in the field of Science	1
Trusting his knowledge in Mathematics	1

As shown in Table 9, most of the teachers stated that they did not feel sufficient in applying STEM, giving feedback, and guiding students (10 teachers). Teachers stated that they did not feel sufficient about STEM due to reasons such as lack of application about he integration of science, technology, mathematics, and engineering (8 teachers), lack of confidence in technology (7 teachers), and lack of self-confidence in designing (6 teachers). On the other hand, two teachers stated that they felt sufficient. One of the teachers stated that he felt sufficient in the application of STEM in science lessons because he felt confident science, and another teacher-trusted his knowledge in the field of mathematics. Sample quotations from the answers obtained from the eighth question of the interview are given below.

"No, I do not feel sufficient. Today, if they ask me to apply this method, I will have problems as I do not have any previous experience, and I have not performed any application in this area or received any training whatsoever. For this reason, I will experience problems in implementation." (Ö1)

'No, I do not feel sufficient because I have not received any relevant training or conducted any relevant practice.' (Ö2)

'I do not feel adequate because the environment and the equipment of the institution I work for are not suitable for me to carry out this training. However, even though it is very rare, I perform such applications, and I have serious difficulties only during the applications. The lack of media and equipment challenges me seriously. I also have not received any training on how to deliver such education.' (Ö9)

3.1.9 Recommendations of pre-service teachers for science teaching based on the integration of science, technology, mathematics, and engineering to be applied by their teachers upon graduation

In the ninth question of the interview, the following question was asked to the teachers: "Do you have any recommendations for science teaching based on the integration of science, technology, mathematics, and engineering to be applied by teachers when they graduate? If so, what are these recommendations?" The data obtained from the ninth question is shown in Table 10.

Table 10: Teachers' suggestions for the implementation of Science teaching based on Science, Technology, Mathematics, and Engineering integration

Recommendations for the implementation of Science teaching based on Science, Technology, Mathematics, and Engineering integration	Frequency
Suggestions	
Taking courses about the application of STEM in the Science course during their undergraduate education	9
Making applications about STEM during the undergraduate education	9
Using Technology more during undergraduate education	8
Participating in the training organized by the MEB taking an active role	7
Preparation of a graduation project about STEM	7
Organizing STEM project competitions attended by faculties of education.	6
	5

As shown in Table 10, nine of the teachers suggested that courses should be received for the implementation of STEM during their undergraduate studies. While eight teachers suggested to practice STEM-related education during their undergraduate education, seven teachers suggested that they should use technology more during their undergraduate education and should participate in the training activities organized by the Ministry of Education and take an active role. Sample excerpts from the answers obtained for the ninth question of the interview are given below.

'I can propose to acquire theoretical and practical knowledge about this subject during the undergraduate education in education faculties. Because I believe that, if the necessary theoretical information is obtained on this subject and necessary practical applications are performed before starting the profession, students will be more successful.' (Ö10)

'My suggestion is to give a comprehensive education on this subject to the teachers..' (Ö3)

3.1.10 Duties of teachers, Ministry of National Education and parents for the successful implementation of science teaching based on the integration of science, technology, mathematics, and engineering.

In the tenth question of the interview, the following question was asked to the teachers: "Explain what can be done for the successful implementation of science teaching based on the integration of science, technology, mathematics, and engineering." The data obtained from the tenth question is shown in Table 11.

Table 11: Duties of teachers, MEB and parents for the successful implementation of Science teaching based on Science, Technology, Mathematics, and Engineering integration

Duties of teachers, MEB and parents for the successful implementation of Science teaching based on Science, Technology, Mathematics, and Engineering integration	Frequency
Duties to MEB	8
In-service training/seminars should be organized	7
Science textbooks with exemplary activities related to STEM should be organized	5
Heterogeneous distribution of specialist teachers to primary schools	2
Tasks for teachers	7
Participating in the in-service training organized by the MEB	6
Using more technological tools in the lesson	5
Helping with teachers in different branches	4
To closely follow the technological developments	4
To follow the developments in Engineering	4
Arranging a lesson plan on subjects where interdisciplinary Science education can be applied	3
Guiding students on the subject	2
Duties to parents	2
Not interfering with the designs of their children	2

As it can be seen in Table 11, there are three categories, namely MEB (8 teachers), teachers (7 teachers) and parents (2 teachers) for successful implementation of teaching (STEM) based on the integration of science, technology, mathematics, and engineering. Seven of the teachers stated that MEB should organize in-service training/seminars, and 5 of the teachers stated that starting from primary education, science textbooks with sample activities related to STEM should be organized at every grade level. In addition, 6 of the teachers stated that science teachers working actively should participate in the in-service training organized by MEB. Five of the teachers mentioned that technological tools should be used more widely in the classes. Finally, two teachers talked about the duties of parents to successfully implement their teaching based on the integration of science, technology, mathematics, and engineering. Two of the teachers stated that parents should not interfere with the designs of their children. Sample quotations from the answers obtained from the tenth question of the interview are given below.

'First of all, in-service training should be provided to the teachers by the ministry, in which teachers are also active. The teacher should follow the developments that are intertwined with our current life, not only in his field but also in different fields such as technology and engineering, and transfer what he learned to the students by giving examples. Teachers should always be open to innovation and should not hesitate to seek help.' (Ö1)

'Teachers should always follow the innovations and improve themselves very well in this regard. They can research this subject on the internet. They can participate in in-service training organized by the Ministry and exchange ideas with their teacher colleagues.' (Ö2)

'First of all, teachers who are the practitioners of this training should be trained on the subject. Adequate equipment support should be provided to public schools. I think that if these are done, every teacher will want to deliver such training.' (Ö6).

IV. DISCUSSION, CONCLUSION, AND RECOMMENDATIONS

Almost all teachers talked about the existence of the relationship between science, technology and mathematics, which is the first question of the interviews conducted with the aim of determining the opinions of the teachers who teach science education in a private school in the TRNC about the integration of science, technology, mathematics, and engineering (STEM). These findings are consistent with other studies (Sungur and Marulcu, 2014; Kızılay, 2016).

When teachers' views on engineering were examined, it was found that all participants (10 teachers) associated engineering with design. At the same time, it was determined that they thought that engineering skills improved psychomotor skills (8 teachers) and helped to produce products and make inventions (7 teachers). The results obtained in this direction are similar to the results of other studies in the literature (Marulcu and Sungur, 2012; Sungur and Marulcu, 2014; Kızılay, 2016; Özçakır and Çalışıcı, 2016; Yıldırım, 2017; Yıldırım and Türk, 2018).

When the opinions of the teachers about whether or not the engineering skills can be gained in science teaching process, the majority of the teachers (9 teachers) expressed their opinion that they can be gained, it has been suggested that engineering skills can be gained by students by conducting activities related to experimental and material design in class (8 teachers), teaching by doing and living (7 teachers), and teaching science (5 teachers) where the creativity of the students is at the forefront. Similar results were found by Marulcu and Sungur (2012), Yıldırım (2017) and Yıldırım and Türk (2018). On the other hand, two teachers stated that these skills could not be gained due to reasons such as the difficulty of access to materials required for this education and the implementation of this method in schools with low economic level, and one teacher each mentioned the subject-centered education in our education system and teachers' inadequacies in this regard.

When the opinions of teachers on teaching a combination of science, technology, mathematics, and engineering were examined, 8 of the teachers stated that teaching involving science, technology, mathematics, and engineering could be carried out and gave examples of how this could be applied in science courses. While giving examples, it was determined by the researcher that teachers had difficulties in including technology and engineering in the process. On the other hand, five teachers stated that interdisciplinary science education could not be carried out in every school in our country due to reasons such as class hours for teachers (4 teachers), the inadequacy of teachers in terms of technology (4 teachers), and the tendency of teachers to prefer short-cuts in teaching (3 teachers). In the literature, Hacıoğlu et al. (2016) found similar results to those obtained in this study.

Among the courses which could be delivered using an integrated approach between science, technology, engineering, and mathematics, physics (8 teachers), biology (5 teachers), and chemistry (4 teachers) were mentioned. In physics, teachers stated that they can be applied mostly on simple electrical circuits and force and motion, on the world of living things in biology, and on heat and temperature in chemistry. In the research, it was determined that teachers had difficulty in giving interdisciplinary teaching on chemistry subjects in science courses. In this context, it could be suggested to undertake studies with more exemplary activities in chemistry within the science course in the literature. In the study conducted by Eroğlu and Bektaş (2016), it was found that this approach can be applied mostly in physics subjects. Then it can be applied in chemistry and biology, respectively. At the end of the research carried out in this study, the finding that interdisciplinary science teaching can be applied in biology subjects after physics topics attracts attention.

In addition, all teachers provided their opinions that interdisciplinary science teaching would be advantageous. In terms of student benefits, they stated that they would make students love science and technology lessons (8 teachers), provide permanent and meaningful learning (7 teachers),

and increase academic success (6 teachers). Similar results are included in the literature (Marulcu and Sungur, 2012; Bozkurt Altan et al., 2016; Çınar, Pirasa and Sadoğlu, 2016; Eroğlu and Bektaş, 2016; Hacıoğlu et al., 2016; Kızılay, 2016; Özçakır and Çalışıcı, 2016; Yıldırım, 2017; Yıldırım and Türk, 2018).

In terms of the advantages of interdisciplinary science teaching as regards teachers, the teachers stated that they would make science teachers realize their competencies (3 teachers), create opportunities for professional development of teachers (2 teachers), and make them love their profession more (2 teachers). Similar results were seen in the literature (Çınar, Pirasa and Sadoglu, 2016; Eroğlu and Bektaş, 2016; Hacıoğlu et al., 2016; Özçakır and Çalışıcı, 2016; Yıldırım, 2017; Yıldırım and Türk, 2018). In terms of the advantages of interdisciplinary science education for our country, teachers mentioned the increase in the quality of education (3 teachers), the training of qualified staff (3 teachers), the increase in technological developments (2 teachers), the provision of better education to students (2 teachers) and the development of the national economy (2 teachers). In studies conducted by Çorlu, Caproro and Çorlu (2015) and Yıldırım (2017), it was argued that interdisciplinary education should be used as an alternative in teacher education. This result is consistent with the data obtained from this study.

Regarding the implementation of interdisciplinary science education, nine of the teachers stated that there might be problems in implementating science education in our country. They mentioned that there may be a problem of training enough teachers (8 teachers), and that most middle-aged and older teachers may be reluctant (7 teachers), that the time is limited (6 teachers), and that budget/materials are inadequate (6 teachers); therefore they expressed that there might be problems in practice. Similar results were found in the literature (Bozkurt Altan et al., 2016; Eroğlu and Bektaş, 2016; Hacıoğlu et al., 2016; Özçakır and Çalışıcı, 2016; Yıldırım, 2017).

All of the teachers (10 teachers) stated that they did not feel sufficient in the implementation of interdisciplinary science teaching. In parallel with this situation, the following determinations were made regarding the ability of teachers to successfully apply interdisciplinary science teaching when they graduate: Nine of the teachers take lessons for the implementation of STEM during their undergraduate education, eight of them apply for STEM during their undergraduate education, and all seven teachers suggested using technology more during their undergraduate studies and taking an active role by participating in the training organized by the ministry. The findings obtained are similar to the ones provided in the literature (Marulcu and Sungur, 2012; Sungur and Marulcu, 2014; Hacıoğlu et al., 2016; Yıldırım, 2017). As stated by Çorlu (2014) and Yıldırım (2017), it is considered that their education in this context is important for educators to graduate with competence from STEM education.

For interdisciplinary science teaching to be applied successfully in our country, the teachers stated that the responsibility falls to the Ministry of National Education followed by teachers and parents. Organizing in-service training/seminars (7 teachers) and organizing science textbooks with sample activities related to STEM (5 teachers) are among the duties of the Ministry of National Education. The findings obtained are similar to the literature (Sungur and Marulcu, 2014; Eroğlu and Bektaş, 2016; Hacıoğlu et al., 2016; MEB-YEĞİTEK, 2016; Yıldırım, 2017). Among the duties assigned to teachers is participation in in-service training organized by the Ministry of National Education (6 teachers) and better use of technological tools in the course (5 teachers). Trying to avoid interfering with the designs of their children (2 teachers) was shown among the duties of the parents in this regard. The findings obtained are similar to the ones found in the studies conducted by Çınar, Pirasa, and Sadoglu (2016) and Yıldırım (2017).

According to the results of the research, it was understood that the teachers who deliver science education did not have difficulty in associating science and mathematics with each other in the integrated science teaching process, which includes science, technology, mathematics, and

engineering. However, it turned out that they had difficulty integrating technology and engineering into the process and designing this education inappropriate science topics. On the other hand, teachers talked about the advantages of interdisciplinary science teaching but stated that there would be problems in implementating all teachers in our country. To successfully implement integrated science teaching in our country upon graduation, they suggested that they take applied courses that would provide teachers with knowledge and experience in this subject during their undergraduate studies. As a result, it was determined that teachers generally have a positive perception about teaching science based on science, technology, mathematics, and engineering, but that they felt the need to have knowledge and experience in this area as well as students in terms of designing and applying science and technology teaching by the interdisciplinary approach.

In line with the data obtained from the research, the following suggestions can be presented.

- Educators working at all levels from pre-school to higher education should be included in the activities for STEM education.
- In future studies, the STEM-related opinions of not only teachers working in the field of STEM but also teachers and pre-service teachers in social branches other than STEM can be examined.
- As a result of the collaboration between YÖK (Higher Education Institution) and MEB, a course on the integration of science, technology, mathematics, and engineering can be offered for students studying in teaching at universities.
- To create a reliable source of information and guide teachers on this issue, sample activities deemed appropriate by the MEB for the implementation of STEM in the teaching process can be posted on the website, and these activities can be made available to pre-service teachers.
- Low-cost STEM activities can be included in the science and technology textbooks.
- Appropriate STEM activities can be organized for education faculties to work in cooperation with engineering faculties and to apply technology and engineering in primary / secondary schools.
- Applied in-service training, where teachers are active, can be provided by MEB to ensure that the teachers on duty are informed about STEM and can conduct implementation.

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