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Content Analysis of the Studies Examining the Teachers' and Pre-service Teachers' Views on STEM Education

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Abstract:

The purpose of this research is to examine the descriptive content of studies examining the views of teachers and pre-service teachers on STEM education in order to shed light on the future. The content analysis method, one of the qualitative research methods, was used to examine postgraduate theses and scientific articles in this study, which is a qualitative study. To that end, the studies under consideration were subjected to descriptive content analysis based on the aim, research designs (method, study group, data collection tools, and data analysis), results, and recommendations. A literature review was conducted for this study using the keywords "view on STEM education," "STEM," "teacher candidate," "pre-service teachers," "opinion about STEM education", "attitude," and "awareness". Seven question titles were determined by examining 23 identified studies, and an attempt was made to answer these questions. The collected data were organized into tables, and their frequency distributions were calculated. According to the results of these investigated studies, it was seen that the highest frequency was belong to the teachers' and pre-service teachers' positive attitudes and views toward STEM. Based on the research findings, the following recommendations can be made: STEM activities can be implemented in teacher education programs to increase student interest in STEM education. STEM education can be included as a practicum in teacher education programs.

Keywords: *Content analysis, STEM education views, teachers and pre-service teachers*

Öğretmen ve Öğretmen Adaylarının FeTeMM Eğitimine Yönelik Görüşlerini İnceleyen Çalışmaların İçerik Analizi

Özet:

Bu çalışmanın amacı geleceğe ışık tutacak olan öğretmen ve öğretmen adaylarının FeTeMM eğitimine yönelik görüşlerini inceleyen çalışmaların betimsel içerik analizini yapmaktır. Bu çalışma nitel bir çalışma olup lisansüstü tez ve bilimsel makaleler, nitel araştırma bstractyöntemlerinden içerik analizi yöntemiyle incelenmiştir. Bu amaçla incelenen çalışmalar; amaç, araştırma deseni (yöntem, çalışma grubu, veri toplama araçları ve veri analizi), sonuç ve önerilere dayalı olarak betimsel içerik analizine tabi tutulmuştur. Bu çalışma için "FeTeMM eğitimine yönelik görüş", "STEM", "aday öğretmen", "FeTeMM eğitimi hakkında düşünceler", "tutum" ve "farkındalık" anahtar kelimeleri kullanılarak alanyazın araştırması yapılmıştır. Tespit edilen 23 çalışma incelenerek, yedi soru başlığı belirlenmiş ve bu sorulara yanıt verilmeye çalışılmıştır. Elde edilen veriler tablolar hâlinde sunulmuş ve frekans dağılımları da belirlenmiştir. İncelenen bu çalışmaların sonuçlarına göre en yüksek frekansın öğretmen ve öğretmen adaylarının STEM'e yönelik olumlu tutum ve görüşlerine ait olduğu görülmüştür. Araştırmadan elde edilen sonuçlara bakılarak şu önerilerde bulunabilir: FeTeMM eğitimine yönelimi artırmak için öğretmen eğitimi programlarında FeTeMM etkinlikleri yapılabilir. Öğretmen eğitimi programlarına FeTeMM eğitimi uygulamalı ders olarak yer alabilir.

Anahtar kelimeler: *İçerik analizi, FeTeMM eğitimi görüşleri, öğretmen ve öğretmen adayları*

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INTRODUCTION

STEM education emerged as a concept at the beginning of the twenty-first century, encompassing the integration of science, technology, engineering, and mathematics disciplines, thereby contributing to individuals' deep and permanent learning and providing the life and professional skills required by the era (Akgündüz et al., 2015; Akyıldız, 2014; Bybee, 2013). Individuals with the knowledge and experience defined as 21st century skills are required to meet the needs of this era, known as the age of technology. From a global standpoint, these capabilities must be used to develop in the twenty-first century and lead civilizations. According to Kılıç and Ertekin (2017), STEM education is a new paradigm put forward to train the human resources needed by the new economy, which is increasingly based on engineering and technology.

Contribution of STEM education to students at all grades -from preschool education to the university- according to the literature can be summarized as in the following: (1) it increases the skills of observation, experimentation and determining variables by enabling the education programs to be comprehended deeply and functionally (Yamak, Bulut & Dündar, 2014), (2) it enables students to understand the sociocultural perspective of the studied subjects and to choose STEM fields while setting their career goals (Moore, 2014), (3) by supporting students to produce projects on any subject they encounter, to provide them with creative and applicable solutions to problems (Rogers & Porstmore, 2004), (4) it contributes to scientific process skills (Strong, 2013), (5) it allows more careful solution to any problem (Wang, 2012), (6) it allows to adapt to future professions such as STEM jobs like physician assistant, software developer, data scientist, etc. (Thomas, 2014).

STEM education, according to Çorlu, Capraro, and Capraro (2014), is strategically important for Turkey's economic competitiveness in the global arena. People who have the qualifications to work in the STEM fields are needed for economic developments feeding with innovation (TÜSİAD, 2017). STEM education, which increases its importance every day, is an integrated approach that makes individuals adopt creative problem solving techniques (Akgündüz et al., 2015; Gülhan & Şahin, 2016). For this reason, STEM education is of great importance for countries to make progress in economic and scientific fields. Şahin, Ayar and Adıgüzel (2014) state that STEM education should be supported by the countries and awareness about STEM should be increased in order for countries to develop and maintain scientific and economic development. Additionally, today's pre-service teachers, who will implement the programs of our future years, are important in terms of taking our country to the top in every field.

As a necessity of the period we live in, we need to structure the information with our previous knowledge by researching and querying. Raising individuals with research and inquiry skills is among the aims of the curriculum. In order for students to learn information meaningfully and permanently, classroom, in-school, and out-of-school learning environments are designed according to the inquiry-based learning strategy (MEB, 2018). When we look at the recent reports and curriculum related to STEM education, it is seen that this approach is on the agenda of the Ministry of National Education (Altunel, 2018). Although it has entered the agenda of the Ministry of National Education, it cannot be said that the steps to be taken regarding STEM have taken place quickly. Although the underlying objective of raising science-literate individuals has not changed, inquiry-based education has been embraced, and the unit of "Science and Engineering Applications" has been introduced to the subject area of "Applied Science" (MEB, 2017). Some objectives in the last unit of each grade level correspond to the

engineering design process steps. The "Science, Engineering Applications" unit was eliminated as the last unit in the curriculum in 2018, and the Zeroth (0th) Unit "Science, Engineering, and Entrepreneurship" was added to all units in the program (MEB, 2018). It can be said that STEM education has been included as engineering applications in education programs since 2017 (Elmas & Gül, 2020). With the inclusion of STEM education in the curriculum, it has become important to investigate the STEM teaching views of teachers and pre-service teachers who are the implementers of the curriculum. Therefore, STEM education has an important place in raising qualified individuals who have the 21st century skills like critical thinking, communication skills, innovation, and collaboration, etc. (Ültay, Dönmez Usta & Ültay, 2021). For this reason, it is important to reveal that teachers' and pre-service teachers' views about implementing STEM or engineering desingns in their classes in future. At this point, it may be necessary to explain the opinion, view, and tendency. An opinion is about what you think about something. However, view refers to how you think about something. According to the dictionary, if someone has a tendency to do or like something, they will probably do it or like it. Moreover, if someone has a tendency to do or like something, it starts to happen more often (URL-1, 2021). Thus, it is thought that the views of teachers and pre-service teachers can include opinions and tendencies. It is difficult to draw lines between these concepts, but it can be said that "view" is broader.

Gülgün, Yılmaz, and Çağlar (2017) stated that science teachers' views on STEM are positive, but the conditions required for STEM to be applicable have not yet been adequately implemented in our country. At this point, this study shed light on why it is difficult to implement STEM in classrooms from the viewpoints of teachers and pre-service teachers. Additionally, there are various studies aimed at determining the views of teachers and pre-service teachers on STEM education. It is thought that gathering these studies under common headings and evaluating their findings together will be a useful study in understanding the views of teachers and pre-service teachers on STEM education better, seeing the studies done in the field as a whole, and seeing the shortcomings in the field. For this purpose, this study is a content analysis of the studies addressing the views of teachers and pre-service teachers. All qualitative and quantitative studies are examined and organized through content analysis and general trends in the field are determined (Ültay, Akyurt & Ültay, 2021). In many content analysis studies do not display a deeply synthesis, but content analysis studies should contribute to the related area/discipline via more deeply analysis and synthesis. It is possible by making a qualitative analysis including creating codes/themes. In this respect, this study is expected to contribute to the science education field. For this reason, the aim of the study is to analyze the content of the studies about the views of teachers and pre-service teachers on STEM education. For this purpose, it was tried to answer the following questions about the studies examined:

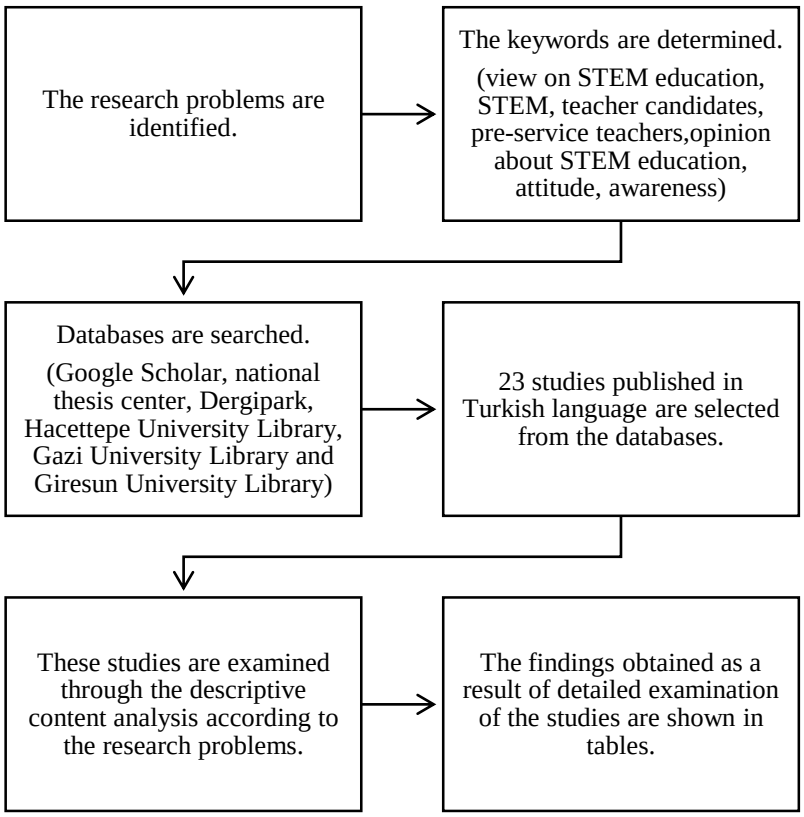
1. What are the aims of the studies addressing the views of teachers and pre-service teachers on STEM education?
2. Which research designs have been used in studies addressing the views of teachers and pre-service teachers on STEM education?
3. What results have been achieved in studies addressing the views of teachers and pre-service teachers on STEM education?
4. Which suggestions have been included in studies addressing the views of teachers and pre-service teachers on STEM education?

METHODOLOGY

This is a qualitative study, and also content analysis, one of the research synthesis (Çalık & Sözbilir, 2014), was used to assess the theses and articles included in the study. For this purpose, content analysis was performed on the studies according to the aim, research design (method, study group, data collection tools, and data analysis), results, and suggestions. Content analyzes are research syntheses that play an important role in disseminating researched knowledge and shaping future research, policies, practices and public perception (Suri & Clarke, 2009). In general, these are divided into three as meta-analysis, meta-synthesis (thematic content analysis) and descriptive content analysis. This study was conducted as a descriptive content analysis study. Descriptive content analysis is a systematic study that includes studies on a specific subject and evaluating the trends and research results in a descriptive dimension (Çalık, Ünal, Coştu & Karataş, 2008; Ültay, Dönmez Usta & Durmuş, 2017; Ültay, Akyurt & Ültay, 2021). In other words, qualitative and quantitative studies conducted independently of each other are examined and organized and general trends in the field are determined (Selçuk, Palancı, Kandemir & Dündar, 2014). Thus, it is shown what the general tendency is to researchers who work in the relevant field and want to do it (Cohen, Manion & Morrison, 2007; Selçuk, Palancı, Kandemir & Dündar, 2014).

For this study, a search was carried out using the keywords "view on STEM education", "STEM", "teacher candidates", “pre-service teachers”, "opinion about STEM education", “attitude”, and “awareness”. These keywords were selected to reveal the studies about exploring the studies on searching for views on STEM education. "Attitude" and "awareness" keywords were chosen for any studies that included views on STEM, because in some studies, researchers search for views or opinions about STEM while attempting to study attitudes toward STEM. Keywords were entered one by one but including STEM word, for example “view STEM”, “awareness STEM”, etc. The summary sections of the studies that were found were assessed first, and those that had no relevance to the issue were deleted. The studies that did not incorporate opinion determination from the purpose and method sections were then excluded from the content analysis, leaving just the remaining studies. Google Scholar, national thesis center (YÖK), Dergipark, Hacettepe University Library, Gazi University Library and Giresun University Library databases were searched and 23 studies published in Turkish language were selected from the resources. 10 of the studies are articles published in the journals, the rest of them are master’s thesis displayed in National Thesis Center. Because research about views on STEM is new in the Turkish educational context, it was preferred that there be no limitations on the publication years of the studies. The studies were published in between 2016-2020 years. The limitation of the study is the inclusion of studies written in Turkish and whose full texts are available from the mentioned databases. The flowchart of the study is shown in Figure 1.

Figure 1. The Flowchart of the Study



Data Analysis

In this study descriptive content analysis technique was used to analyze data. To make it easier to analyze the articles, each one was named as A1, A2, ..., A10, and for the thesis each one was named as T1, T2, …, T13 and these names were used in the study. The data from each study were analyzed using the "Examination Form" developed by the researchers previously (Ültay, Dönmez Usta & Ültay, 2021) within the scope of the research. While developing the examination form, it was finalized within the scope of the necessary feedback by soliciting the opinions of field experts.

Validity and Reliability

The research studies were examined at various times and locations, and the data obtained as a result of the examinations were recorded on the examination form. The Cohen's Kappa Coefficient value between the two readers was calculated using the SPSS v.22 package program to ensure the reliability of two valuers. Cohen's Kappa coefficient was calculated as .843 were discovered, and almost perfect agreement was observed using the classifications of Landis and Koch (1977). The reader reliability of the study was attempted in this manner.

FINDINGS

In this section, the findings obtained as a result of detailed examination of the studies selected for research are included. The data obtained for the research questions are summarized in the tables below.

(1) The aims of the studies addressing the views of teachers and pre-service teachers on STEM education

Table and explanations regarding the aims of the studies conducted to examine the views of teachers and pre-service teachers on STEM education are given below.

Table 1. The Aims of the Studies

Aims	**Studies***	***f***
Determination of teachers' and pre-service teachers' views on STEM education	A3, T2, A4, A6, T8, A8, A9, T13	8
Examining the awareness of teachers and pre-service teachers about STEM	A2, T5, A5, T8, A8, T9, A10	7
Analysis of teachers' pre-service teachers' teaching tendencies on STEM education according to different variables	T3, T4, A7, T10, T12	5
Determination of teachers' and pre-service teachers' attitudes towards STEM education	T2, T6, T11, T12	4
Determining the teaching tendencies of teachers and pre-service teachers for integrated STEM teaching	A1, T1, T9, T10	4
Determining teachers' and pre-service teachers' self-efficacy regarding STEM education	T2, T11	2

*Some of the studies can be grouped under two or more categories.

When Table 1 is examined, it is seen that the study with the highest frequency has the purpose of "determination of teachers and pre-service teachers' views on STEM education." The aim of the study with the closest frequency to this is to "examining the awareness of teachers and pre-service teachers about STEM." The frequencies of the studies conducted with the aim of "determination of teachers and pre-service teachers' attitudes towards STEM education" and "determining the teaching tendencies of teachers and pre-service teachers for integrated STEM teaching" are four and equal to each other. The study conducted with the aim of "determining teachers' and pre-service teachers ' self-efficacy regarding STEM education" is the one with the lowest frequency.

(2) Research designs of the studies addressing the views of teachers and pre-service teachers on STEM education

Tables and explanations regarding the methods used in studies conducted to examine the views of teachers and pre-service teachers on STEM education are given below.

Table 2. The Methods of the Studies

Methods	**Studies***	***f***
Quantitative	A1, A2, T2, T3, T4, T7, A5, A7, T8, T9, T10, T12, A10	14
Qualitative	A3, T2, A4, A6, A8, A9, T13	7
Mixed	T1, T5, T6, T11	4

*Some of the studies can be grouped under two or more categories.

As can be seen in Table 2, studies were mostly carried out with quantitative research methods. Qualitative research was the method with the second highest frequency used in this study. The least preferred method in the studies examined was the mixed method. Among mixed methods, T1 used intertwined experimental design, T5 used experimental design, and T6 and T11 used experimental designs for the quantitative parts of their studies. T6 used phenomenological research designs for the qualitative part of the study.

Tables and explanations regarding the samples preferred in studies conducted to examine the views of teachers and pre-service teachers on STEM education are given below.

Table 3. The Sample groups of the Studies

	Pre-service teachers*	***f***	**Teachers***	***f***
Science Education	A1, T1, A3, T2, T3, T4, T7, A4, A5, A7, T9, T10, T11, A10	14	A8, A9	2
Elementary Education	A1, T3, T4, A7, A10	5	T8, T12	2
Preschool Education	A1, A2, T4	3		
Computer and Instructional Technologies Education	A1, T6, T7	3		
Mathematics Education	T3, T4, T7, A7, A10	5	A8	1
Physics Education	T7, A5, T13	3		
Chemistry Education	T7, A5, A6	3		
Biology Education	T5, T7, A5	3		
Branch is not specified			T12	1

*Some of the studies can be grouped under two or more categories.

When Table 3 is examined, it is seen that the most preferred sample group in the studies is pre-service science teachers. The second preferred sample group is Elementary Education pre-service teachers. The table shows that the sample groups of Computer and Instructional Technologies, Preschool, Chemistry, Biology, and Physics education pre-service teachers are preferred in the same number of studies. T7 is the study in which the most different types of sample was used. In this study, data were collected from a total of eight different branches. Apart from pre-service teachers, science teachers, elementary teachers, mathematics teachers were preferred as sample groups. T12 named study used elementary, secondary and high school teachers but there was no explanation about the branches of secondary and high school teachers.

Tables and explanations regarding the data collection tools preferred in studies conducted to examine the views of teachers and pre-service teachers on STEM education are given below.

Table 4. The Data Collection Tools of the Studies

Data Collection Tools	**Studies***	***f***
Questionnaire	A1, A2, T1, T2, T3, T4, T6, T7, A5, A7, T8, T9, T10, T11, T12, A10, T13	17
Interview	T1, A3, T2, T5, T6, A4, A8, A9	7
Information Form	A2, T4	2
Reflective Diary	T1, A6	2
Survey	T6	1
Word Association Test	T1	1

*Some of the studies can be grouped under two or more categories.

When Table 4 is examined, it is seen that the most used data collection tool is questionnaire. "STEM Attitude Scale" (T6) and "Teacher Self-efficacy Belief Scale" (T2), "The scale of Attitudes towards Technology" (A1) and "Integrated STEM Teaching Orientation Scale" (T3) can be given as examples for questionnaire. In the studies covered in this research, it is seen that different data collection tools are mostly used in T1. The least preferred data collection tools are surveys and word association tests.

Tables and explanations regarding the data analysis techniques preferred in studies conducted to examine the views of teachers and pre-service teachers on STEM education are given below.

Table 5. The Data Analysis Techniques of the Studies

Data Analysis Techniques	**Studies***	***f***
Statistical Package Programs	A1, A2, T1, T4, T7, A5, A7, T9, T10, T11, T12, A10	12
Content Analysis	T1, A3, T5, A4, A6, A7, T8, A9, T11, T13	10
Descriptive Analysis	T2, T3, T6, A4, A6	5
Comparative Analysis	T2, A6	2

*Some of the studies can be grouped under two or more categories.

When Table 5 is examined, statistical package programs were preferred to provide the analysis of the data such as SPSS. The second highest frequency of data analysis method is content analysis. Because most of the studies used quantitative methods, it is expectable to be preffered to use SPSS by the studies.

(3) Results of the studies addressing the views of teachers and pre-service teachers on STEM education

Tables and explanations regarding the results of the studies conducted to examine the views of teachers and pre-service teachers on STEM education are given below.

Table 6. The Results of the Studies

Positive Thoughts/Feelings		
Results of the Studies	**Studies***	***f***
STEM seems to have a positive tendency	A1, T1, T2, T3, T4, A7, T10	7
Positive viewpoint	T2, T5, T6, A4, T8	5
STEM activities increased students' interest and motivation in science lessons.	A3, T2, T6, T7, T13	5
It was observed that the STEM teaching tendencies of the female pre-service teachers was higher than the male pre-service teachers.	T3, A5, T9	3
Positive attitude towards STEM	A1, T11, T12	3
Pre-service teachers found STEM applicable.	T5, T13	2
Awareness about STEM		
Results of the Studies	**Studies***	***f***
STEM-related or STEM-based courses increased the pre-service teachers' awareness of STEM education.	A2, A3, T4, T7	4
STEM-related or STEM-based courses increased the teachers' awareness.	T8, A10	2
Teachers have a higher level of STEM awareness than pre-service teachers.	A5	1
Skill Development		
Results of the Studies	**Studies***	***f***
STEM activities have been shown to improve pre-service teachers' creativity, problem-solving abilities, and 21st-century skills.	A3, T2, T6, T12	4
Self-Efficacy Development		
Results of the Studies	**Studies***	***f***
STEM activities increased pre-service teachers' self-efficacy.	A3, T5, T11	3
STEM activities had no effect on the self-efficacy of pre-service teachers.	T2	1
Relating STEM Disciplines		
Results of the Studies	**Studies***	***f***
The teachers and pre-service teachers associated STEM education with related disciplines.	A3, T2, A6, A9	4
It is seen that pre-service teachers associate at least two fields while defining the concept of STEM.	A3	1
Science teachers mostly associated STEM with physics.	A9	1

Contribution to Learning		
Results of the Studies	**Studies***	***f***
STEM-related or STEM-based courses have contributed positively to permanent learning.	A6, T13	2
Negative Thoughts/Feelings		
Results of the Studies	**Studies***	***f***
It is seen that pre-service teachers are concerned about designing activities in STEM education.	T4, A8	2
Due to a lack of materials, science teachers stated that they were unable to conduct STEM activities.	A9	1

*Some of the studies can be grouped under two or more categories.

When Table 6 is examined, it is seen that the results of the study are collected in seven different categories. The categories are formed according to the common points of the results. The result category with the highest frequency was "Positive thoughts/feelings" about STEM. The result category with the lowest frequency was "Contribution to learning." This result coincides with the fact that Science Education is given more weight in the branches chosen for the sample in the 23 studies discussed in this study. There are many different results about the relationship of gender with STEM. For example some studies reached the result of "It was observed that the STEM teaching tendencies of the female pre-service teachers was higher than the male pre-service teachers." while some reached that "It was observed that gender had no effect on the attitude and awareness towards STEM education." There are studies in the literature that have found many different results about the relationship of gender with STEM.

(4) Suggestions of the studies addressing the views of teachers and pre-service teachers on STEM education

Tables and explanations regarding the suggestions of the studies conducted to examine the views of teachers and pre-service teachers on STEM education are given below.

Table 7. The Suggestions of the Studies

Suggestions for education programs		
Suggestions of the Studies	**Studies***	***f***
STEM education can be incorporated into teacher education programs as a practical course or as a part within existing courses in education faculties.	A1, A2, A3, T2, T3, T4, T6, T7, A5, A6, T9, T11, T12, A10, T13	15
In order for the STEM approach to be applied effectively, infrastructure problems should be eliminated and the necessary budget should be provided.	T2, T6, A9, T11	4
STEM education should be given importance to gain 21st century skills in education programs.	T6	1
Suggestions for researchers		
Suggestions of the Studies	**Studies***	***f***
More studies on this subject are recommended in order to explore STEM teaching tendencies of teachers and pre-service teachers.	T1, A3, T3, T5, A4, A7, T8, A9, T9, T10, T12	11
Suggestions for teachers/pre-service teachers		
Suggestions of the Studies	**Studies***	***f***
In-service trainings can be organized for teachers to introduce STEM.	T6, A5, T8, A8, A9, T11	6
STEM activities, science camps and trainings should be organized to increase the awareness of teachers.	A2	1
STEM activities, science camps and trainings should be organized to increase the self-efficacy of teachers and pre-service teachers.	T7	1

*Some of the studies can be grouped under two or more categories.

When Table 7 is examined, the suggestions are grouped under different categories such as suggestions for education programs, for researchers and teachers/pre-service teachers. The most used suggestion in the studies is "STEM education can be incorporated into teacher education programs as a practical course or as a part within existing courses in education faculties". In these studies, it is stated that practices will improve the knowledge and skills of teachers and pre-service teachers about STEM. The second suggestion with the highest frequency follows: "More studies on this subject are recommended in order to explore the STEM teaching tendencies of teachers and pre-service teachers." Because STEM education can be counted as new, more studies are recommended to be performed under different conditions or with different samples. Similar recommendations appear to be included in many studies.

DISCUSSION

The aim of this study is to analyze the content of the studies examining the views of teachers and pre-service teachers on STEM education. It was observed that the studies examined mainly aimed at "determination of views of teachers and pre-service teachers on STEM." The reason of this can be that STEM education is still new for Turkish educational system. Therefore, the researchers may try to reveal the real implementers' (teachers and pre-service teachers) awareness and views about STEM education and try to reveal the negative and positive views/sides of STEM education.

According to the research designs of the studies examined in this research, it can be said that quantitative studies show the results of what the research question was and display a more holistic view. In other words, for example A1 was carried out quantitatively and its aim was to reveal the pre-service teachers' tendencies of STEM teaching and attitudes towards technology. At the end of the study, it is found that pre-service teachers had positive STEM teaching tendency and positive attitude towards technology. But in A3, which was carried out qualitatively, the aim was "determination of pre-service science teachers' views on STEM applications", and at the end of the study it was found that "STEM activities increased students' interest and motivation in science lessons", "STEM-related or STEM-based courses increased the pre-service teachers' awareness of STEM education", "STEM activities have been shown to improve pre-service teachers' creativity, problem-solving abilities, and 21st-century skills". In this respect, it can be said that qualitative studies can provide a broader perspective. Additionally, in T1, which was carried out in a mixed research design, aimed to investigate cognitive structures, problem solving skills and the integrated STEM teaching orientation of pre-service science teachers. In this study, scales (quantitative) and reflective diaries (qualitative) were used together to support each other. Thus, this study presented more comprehensive and pluralistic viewpoint to the readers (Baki & Gökçek, 2012). In this study it is seen that quantitative research designs are mostly used but in the literatüre mixed methods are mostly preferred because of presenting more comprhensive and detailed data (Ormancı, 2020; Sarıca, 2020).

Considering the sample group of the studies, teachers and pre-service teachers were included in the studies from 8 different branches for 23 studies. Pre-service science teachers and science education teachers were mostly chosen sample groups in the studies. The reason of this can be science is one of the main components of STEM. In STEM activities, at least two components of four disciplines should be existed (Aydın Günbatar, 2019). It is seen that the studies about STEM education comprises of science or mathematics as the main component and then the other disciplines are preferred as supplementary disciplines (i.e Altan, Yamak & Kırıkkaya, 2016; Gülhan & Şahin, 2016; Hacıoğlu, 2017). In the studies it is found that the sample groups

is mainly related STEM with related disciplines. In some studies, STEM is related to physics and chemistry disciplines practical side of the applications but not biology (A3). The reason of this biology course is seen as more verbal in general. A9 is also stated that science teachers mostly associated STEM with physics. STEM actually depends on making innovations that can add value to real life by taking the theoretical knowledge of sciences such as physics, biology, chemistry and mathematics and blending them with the practice of technology and engineering (Uzunyol, 2019). In this respect, in STEM education, teachers are expected to master the content of disciplines, to have high-level pedagogical knowledge, to apply new approaches and to improve their environment (Çorlu, Capraro, & Capraro, 2014). The integration of technology education, an essential component of STEM education, with basic sciences provides the experience of transforming the theoretical infrastructure of science and mathematics disciplines into a product. Since the 1990s, attempts have been made to articulate technology and design, but a lack of basic science infrastructure in design has prevented a successful outcome (Banks & Barlex, 2014). In Turkey, National Ministry Education supported STEM education and made some changes for STEM's implementation from 2018 (MEB, 2018). But actually it requires to re-shape whole educational system.

When the results of the studies are examined, it is revealed that the teachers and pre-service teachers have/show positive attitudes and views towards STEM. This result is compatible with the other studies in the literature. It is stated in these studies that information technologies, science, preschool and elementary education teachers have positive attitudes towards STEM (Çevik, Danıştay, & Yağcı, 2017; Karahan, Canbazoğlu Bilici, & Ünal, 2015; Knop et al., 2017; Ültay & Ültay, 2020). It was stated that in this research, some studies found STEM education effective at improving learning by doing, making learning permanent, directing research and inquiry, in the development of problem solving skills, making learning enjoyable, and being successful in learning subjects. In the study of Altan, Yamak and Kırıkkaya (2016), pre-service science teachers stated that they found STEM education useful and effective for the same reasons. Similar studies on the impact of STEM education on success in learning have also been existed in the literature (i.e Cotabish, Dailey, Robinson, & Hughes, 2013; Herdem & Ünal, 2018; Park & Yoo, 2013). Furthermore, after pre-service teachers did STEM implementation, they felt that they had self-efficacy about science teaching. In contrast, T2 found no effect of STEM activities on self-efficacy and Siew, Amir and Chong (2015) found that teachers felt uncomfortable while implementing STEM activities due to the lack of content knowledge of STEM disciplines. All in all, the results of studies show that teachers and pre-service teachers have positive thoughts in terms of applicability, awareness, attiude, etc. And they want to implement STEM in their classrooms. However, they have some concerns about the implementation process. Some of them felt themselves insufficient in terms of content knowledge, some of them worried about the lack of materials. It means that teachers and pre-service teachers are willing to be a part of STEM activity, but some points should be overcome by education faculties (by adding STEM courses as an obligatory course) and by National Ministry Education in supporting funds and materials. To keep up with the times and trends, to grow up citizents with 21st century skills (innovation, collaboration, creativity, etc.), it is important to do what should be done.

When the studies are examined, it is understood that the most suggestions are that STEM should be a separate course or a part of an existing course. This suggestion is often mentioned in the literature (Karademir Coşkun, Alakurt & Yılmaz, 2020). In addition, practices that will improve the knowledge and skills of teachers and pre-service teachers about STEM education can be included in in-school and out-of-school learning environments such as field trips,

projects, laboratory applications and workshops. All things considered, it is seen that in the studies, teachers and pre-service teachers have a positive insight into STEM and they want to implement it, but they also want their problems and concerns are solved. Suggestions are made in this respect. An important number of studies suggest more studies should be done about STEM because STEM is an area that should be investigated better.

CONCLUSIONS and RECOMMENDATIONS

In light of widely examined opinion studies on STEM, it has been attempted to present a limited perspective to teachers and teacher candidates. As a result of this study, it was discovered that teachers and pre-service teachers have a general understanding of STEM. Because the studies were mostly conducted with pre-service teachers and a small number of teachers, STEM practitioners' perspectives on STEM emerged. As a result, while some pre-service teachers and teachers believe they lack content knowledge, others expect assistance in establishing the necessary infrastructure. However, they mostly display positive views, to implement STEM education in schools is quite difficult for Turkey because it requires revising and/or re-designing the Turkish educational system. To accomplish this revision is required too many infrastructural changes and financial support. Thus, STEM education is in progress in particular activities in Turkey. This study may be useful for researchers and educators who want to study STEM. It hints at which subject / field they should concentrate on or which studies they should pursue. Based on the results of the research, the following suggestions can be made:

- STEM activities can be conducted in teacher education programs (in those that have not been regulated for STEM) to increase the tendencies towards STEM education.
- STEM education can be included in teacher education programs as an applied lesson.
- These studies can be carried out in all branches and at all grade levels, which can both raise awareness and contribute to literature studies.

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GENİŞ ÖZET

Giriş

FeTeMM eğitimi; fen, matematik, mühendislik ve teknoloji disiplinlerinin kendi aralarında entegrasyonu ile ortaya çıkan, bireylerin derinlemesine ve kalıcı öğrenmesine katkı sağlayan, çağın gerektirdiği yaşam ve meslek becerilerini kazandıran bir kavram olarak 21. yüzyıl başında ortaya çıkmıştır. Teknoloji çağı olarak nitelendirdiğimiz bu dönemin ihtiyaçlarını karşılamak için 21. yüzyıl becerileri olarak tanımlanan bilgi ve tecrübelere sahip bireylere ihtiyaç duyulmaktadır.

Her geçen gün önemini daha da artıran FeTeMM eğitimi, bireylere yaratıcı problem çözme tekniklerini benimseten bütünleşik bir yaklaşımdır. Bu sebeple FeTeMM eğitimi, ülkelerin ekonomik ve bilimsel alanda ilerleme kaydedebilmesi için büyük önem taşımaktadır. Ülkelerin bilimsel ve ekonomik alanlarda gelişim sağlayabilmesi ve bunu sürdürülebilmesi için FeTeMM eğitiminin desteklenmesi ve FeTeMM'e ilişkin farkındalığın artırılması gerektiğini ifade edilmektedir.

Öğretmen ve öğretmen adaylarının FeTeMM eğitimine yönelik görüşlerini belirlemeye yönelik çeşitli çalışmalar mevcuttur. Bu çalışmaların ortak başlıklar altında toplanması, bulgularının birlikte değerlendirilmesinin öğretmeni adaylarının FeTeMM eğitimine yönelik görüşlerini daha iyi anlamada yol gösterici olabilir. Bu anlamda alanda bu konuda yapılmış çalışmaları bir bütün olarak görmek, alandaki eksiklikleri de görebilme açısından faydalı olabilir. Bu sebeple çalışmanın amacı öğretmen ve öğretmen adaylarının FeTeMM eğitimine yönelik görüşleri hakkında yapılmış çalışmaların içerik analizini yapmaktır.

Yöntem

Bu çalışma nitel bir çalışma olup tez ve makaleler nitel araştırma yöntemlerinden içerik analiziyle incelenmiştir. Bu amaçla incelenen çalışmalar üzerinde, amaç, yöntem, çalışma grubu, veri toplama araçları, verilerin analizi, sonuç ve önerilerine göre içerik analizi yapılmıştır. İçerik analizleri; araştırılan bilginin yaygınlaştırılması ve gelecek araştırmaların, politikaların, uygulamaların ve kamu algısının şekillendirilmesinde önemli bir role sahip olan araştırma sentezleridir.

Bu çalışma için "FeTeMM eğitimine yönelik görüş", "STEM", "aday öğretmen", "tutum", "farkındalık" anahtar kelimeleri kullanılarak araştırma yapılmıştır. Google Akademik, YÖK ulusal tez merkezi, Dergipark, Hacettepe Üniversitesi Kütüphanesi, Gazi Üniversitesi Kütüphanesi ve Giresun Üniversitesi Kütüphanesi veri tabanlarında arama yapılmış ve ulaşılan kaynaklardan, 23 çalışma tespit edişmiştir. Elde edilen bulgular tablolar hâlinde Bulgular kısmında sunulmuştur.

Bulgular

Amaç tablosu incelendiğinde en fazla frekansa sahip olan çalışmanın "Öğretmen ve öğretmen adaylarının FeTeMM hakkındaki görüşlerinin belirlenmesi" amacını taşıdığı görülmüştür. Buna en yakın frekanstaki çalışmanın amacı "Öğretmen ve öğretmen adaylarının FeTeMM eğitimi hakkındaki farkındalıklarını belirlemek" amacı gelmektedir. İncelenen çalışmalar daha çok nicel araştırma yöntemiyle yapılmıştır. Nitel araştırma bu çalışmada

kullanılan en fazla ikinci yüksek frekansa sahip olan yöntemdir. İncelenen çalışmalarda yöntem olarak en az tercih edilen yöntem ise karma yöntem olmuştur.

Örneklem grubuna ilişkin tablo incelendiğinde ise ele alınan çalışmalarda en fazla örneklemin öğretmen adaylarından oluştuğu ve fen eğitimi branşından oldukları görülmektedir. Onu takip eden ikinci örneklem için seçilmiş olan branş ise sınıf ve matematik öğretmen adaylarıdır. Çalışmalarda en fazla kullanılan veri toplama aracının ölçekler olduğu görülmektedir. Bu ölçekler "FeTeMM Eğitimi İle İlgili Tutum" ve "FeTeMM Eğitimi İle İlgili Özyeterlik Ölçeği", "Teknolojiye Yönelik Tutum Ölçeği" ve "Entegre FeTeMM Öğretimi Yönelim Ölçeği" örnek olarak verilebilir.

Veri analizi tablosuna göre verilerin analizinin sağlanmasında en fazla istatistik paket programları tercih edilmiştir (SPSS gibi). İkinci en yüksek frekansa sahip olan veri analiz yöntemi içerik analizidir. Çalışma sonuçlarının sekiz ayrı kategoride toplandığı görülmektedir. Kategorilere ait frekans dağılımları birbirine oldukça yakındır. En fazla sonucun "Öğretmen ve öğretmen adaylarının FeTeMM'e yönelik olumlu tutum ve görüş sergilediklerini ortaya konmuştur" olduğu görülmektedir.

Ele alınan çalışmalarda en fazla sunulan önerinin ise "FeTeMM farkındalıklarını geliştirecek hizmet içi eğitimler, bilim kampları düzenlenmesinde fayda vardır. Ayrıca alan gezileri, proje, laboratuvar uygulamaları ve atölye çalışmaları gibi okul içi ve okul dışı öğrenme ortamlarında öğretmen ve öğretmen adaylarının FeTeMM eğitimi ile ilgili bilgi ve becerilerini geliştirecek uygulamalara yer verilebilir" olduğu görülmektedir.

Sonuç ve Öneriler

Genel olarak, Türkiye'de FeTeMM ile ilgili genel eğilimin öğretmen ve öğretmen adaylarının tutum ve görüşlerini ortaya çıkarmak olduğu söylenebilir. Ancak çoğunlukla olumlu tutum ve görüşler sergilemektedir, FeTeMM eğitimini okullarda uygulamak, Türk eğitim sisteminin gözden geçirilmesini ve/veya yeniden tasarlanmasını gerektirdiğinden, Türkiye için oldukça zordur. Bu revizyonu gerçekleştirmek için çok fazla altyapı değişikliği ve finansal desteğe ihtiyaç vardır. Bu nedenle Türkiye'de FeTeMM eğitimi belirli etkinliklerle devam etmektedir.

Bu çalışma, öğretmenlerin ve öğretmen adaylarının bakış açılarından FeTeMM eğitimine bir bakış sunmaktadır. Özellikle FeTeMM eğitimi almak isteyen araştırmacılar ve eğitimciler için faydalı olacaktır. Hangi konu/alan üzerinde yoğunlaşmaları gerektiğini veya hangi çalışmaları sürdürmeleri gerektiğinin ipuçlarını verecektir. Bu kapsamda araştırmacılara, "Öğretmen yetiştirme programlarında FeTeMM eğitimine yönelik eğilimleri artırmak için FeTeMM etkinlikleri yapılabilir", "Öğretmen yetiştirme programlarında FeTeMM eğitimine uygulamalı ders olarak yer verilebilir" "Bu çalışmaların tüm branşlarda ve tüm sınıf seviyelerinde gerçekleştirilebilmesi hem farkındalık yaratacak hem de literatür çalışmalarına katkı sağlayacaktır" önerileri sunulmuştur.

Kaynak Gösterimi İçin (For cited in):

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