REPUBLIC OF TURKEY

YILDIZ TECHNICAL UNIVERSITY

GRADUATE SCHOOL OF NATURAL AND APPLIED SCIENCES

SCIENCE, TECHNOLOGY, ENGINEERING, MATHEMATICS EDUCATION: IN-SERVICE SCIENCE TEACHERS' VIEWS, ATTITUDES AND READINESS

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MSc. THESIS

Department of Mathematics and Science Education

Program of Science Education

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July, 2019

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A thesis submitted by Rukiye Bektaş in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE is approved by the committee on 04.07.2019 in Department of Mathematics And Science Education Program of Science Education.

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Rukiye BEKTAŞ

Signature

Dedicated to my beloved family…

ACKNOWLEDGEMENTS

First, I would like to express my sincere gratitude to my thesis advisor Prof. Dr. Bayram Coştu, for his constant support, positive attitude and eternal patience. He illuminates this thesis journey with his inspirational views and comments. I have learned a lot from him and I believe there is still more to learn.

Special thanks to my friends, for helping me get through difficult times, and for their friendship and emotional support they provided. I feel very fortunate to be able to studied with special friends like them in my education journey.

Last and most, I would like to express my deepest gratitude to my parents Havva and Nejat Bektaş and also my brother Ahmet Kutay Bektaş. My accomplishments would not be meaningful and possible without them. I am very thankful for their endless love, support and guidance through my life.

My parents, my brother, my best friends and my teachers - Thank you for all the beautiful things that you have added to my life.

July, 2019

Rukiye Bektaş

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LIST OF ABBREVIATIONS

BA	Bachelor of Arts
MA	Master of Arts
MOE	Ministry of Education
PhD	Doctor of Philosophy
STEM	Science, Technology, Engineering, Mathematics
YTU	Yıldız Technical University

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ABSTRACT

Science, Technology, Engineering, Mathematics Education: In-Service Science Teachers' Views, Attitudes And Readiness

Rukiye BEKTAŞ

Department Of Mathematics and Science Education

MSc. Thesis

Advisor: Prof. Dr. Bayram COŞTU

The aim of the study is to reveal in-service science teachers' attitudes, views and readiness for STEM education. For this aim, this study was conducted in two parts. In the first part, in order to examine attitude and readiness of the in-service science teachers, T-STEM survey [69] which consists of 9 different parts, was implemented on the participants. In the second part, semi-structured interviews which consist of 6 questions were done to reveal views of the participants.

This study was conducted with 80 in-service science teachers who work in public or private schools. Sample of this research consists of 20 male and 60 female volunteer in-service science teachers with a mean age of 29. In service science teachers who are participated to study have different educational backgrounds. Also, they had on average 2-5 years of teaching experience. Some of the participants have prior experience on teaching STEM. To analyze first part of the data different parametric tests such as t-test, one-way analysis of variance (ANOVA) and correlation analysis were used. For the second part of the data, content analysis technique was used by the researcher.

The results of the analysis indicated that 25% of the participants had STEM education and others did not. Although many of them did not have any STEM education beforehand, most of the in-service science teachers have positive attitude towards STEM education according to their hearings about STEM. They believe that this approach will increase success of the students. Participants who had STEM education used STEM in their classes. However, they stated that physical circumstances of the schools, readiness of the in-service science teachers in Turkey is not enough to apply STEM education yet. Besides, participants who did not have STEM education stated that they do not know how to teach with STEM so that they do not feel confident enough to lead students to follow STEM related career paths. As a result of these, participants stated that there is need of content knowledge, practice guideline, experience opportunity and suitable physical conditions to teach with using STEM.

Key words: STEM education, in-service science teachers, readiness, attitudes, views

ÖZET

Fen, Teknoloji, Mühendislik, Matematik Eğitimi: Hizmet İçi Fen Bilgisi Öğretmenlerinin Görüşleri, Tutumları ve Hazırbulunuşlukları

Rukiye BEKTAŞ

Matematik ve Fen Bilimleri Eğitimi Anabilim Dalı

Yüksek Lisans Tezi

Danışman: Prof. Dr. Bayram COŞTU

Bu çalışmanın amacı, hizmet içi fen bilgisi öğretmenlerinin FeTeMM eğitimine yönelik tutumlarını, görüşlerini ve hazırbulunuşluklarını ortaya koymaktır. Bu amaçla, bu çalışma iki bölüm halinde yürütülmüştür. Birinci bölümde fen bilgisi öğretmenlerine, tutum ve hazırbulunuşluklarını ölçmek amacıyla 9 farklı bölümden oluşan T-STEM anketi [69] uygulanmıştır. İkinci bölümde ise katılımcıların FeTeMM eğitimi ile ilgili görüşlerini detaylı olarak ortaya koymak için 6 yarı yapılandırılmış sorudan oluşan görüşmeler yapılmıştır.

Araştırmacı bu çalışmayı kamu ve özel okullarda çalışan 80 hizmet içi fen bilgisi öğretmeni ile gerçekleştirmiştir. Araştırmanın örneklemini, yaş ortalaması 29 olan 20 erkek ve 60 kadın gönüllü fen bilgisi öğretmeni oluşturmaktadır. Araştırmaya katılan hizmet içi fen bilgisi öğretmenlerinin farklı eğitim geçmişleri ve ortalama 2-5 yıllık öğretim deneyimleri vardır. Katılımcılardan bazıları, FeTeMM öğretimi konusunda önceden deneyime sahiptir. Verilerin ilk kısımlarını analiz etmek için t-testi, tek yönlü varyans analizi (ANOVA) ve korelasyon analizi gibi farklı parametrik testler kullanıldı. Verilerin ikinci kısmının analizi için araştırmacı tarafından içerik analizi tekniği kullanılmıştır.

Analiz sonuçları, katılımcıların %25'inin FeTeMM eğitimi aldığını ve diğerlerinin almadığını göstermektedir. Bu duruma rağmen araştırma sonuçları gösteriyor ki hizmet içi fen bilgisi öğretmenlerinin çoğu FeTeMM eğitimi ile ilgili duyduklarından yola çıkarak FeTeMM eğitimine karşı olumlu tutum içerisindeler. Bu yaklaşımın öğrencilerin başarılarını artıracağına inanıyorlar. Ayrıca önceden FeTeMM eğitimi almış olan katılımcılar FeTeMM'i sınıflarında kullandıklarını ancak, okulların fiziki koşullarının ve Türkiye'deki hizmet içi fen bilgisi öğretmenlerinin hazırbulunuşluklarının henüz FeTeMM eğitimini uygulamak için yeterli olmadığını belirttiler. Ayrıca, FeTeMM eğitimine sahip olmayan katılımcılar, FeTeMM konusunda eğitim vermek ve bu alandaki mesleklere öğrencileri yönlendirmek konusunda gerekli öz yeterliliğe sahip olmadıklarını belirttiler. FeTeMM eğitimi, öğretim rehberi, deneyim fırsatı ve uygun fiziksel koşullara ihtiyaç olduğunu eklediler.

Anahtar Kelimeler: FeTeMM eğitimi, hizmet içi fen bilgisi öğretmenleri, hazırbulunuşluk, tutum, görüş

1
Introduction

1.1 Literature Review

This chapter provides related researchs under two main titles; (a) STEM education, (b) Teachers' conceptualization of STEM education. First, the chapter explains history, implementation and effectiveness of STEM education. Then the chapter moves on to elaborate STEM education to frame focus of the thesis within context of Turkish educational system. Later, the chapter explains teachers' conceptualization of the STEM education by considering their readiness, attitude and views. After describing the related literature, this chapter concludes by objectives of present study.

1.1.1 STEM Education

According to the Organization for Economic Co-operation and Development (OECD) [48], in order to obtain sustainable economic growth, countries have to invest science, technology, engineering and mathematics (STEM) literate work force which will work in technology and science related jobs as a result of the transition to Digital Age from Industrial Age, countries have to prioritize STEM education [51]. Economics, politics and international affairs show that there has been an emerging need to prepare students for STEM career fields, which puts an emphasis on STEM education [70]. Educating new generation according to skills of 21st century directed educators to create STEM education which is an interdisciplinary approach. Interdisciplinary characteristic of STEM education creates a harmony of four disciplines and their subcategories, which overlaps every aspects of a real life problem [49].

Although there is an emerging need, students' interest of pursuing STEM related careers have been shown gradually decreasing profile all around the world [13][14][48][52][59][60]. By considering this situation, STEM education have been promoted by governments and educational initiatives. Stakeholders of STEM education such as teachers or policy makers have different understandings of STEM education [8]. As Breiner et.al [7] explain, some of them accept it as integration of four disciplines to solve real life problems and the other ones accepted it as traditional coursework which lacks integration. However, all stakeholders have agreed on STEM being one of the top educational priorities [61]. As Breiner et al. [7] explained, policy makers and educators become aware of STEM being important focus of education reform and global competitiveness, which evolved from governmental policy with the guidance from National Science Foundation. In order to educate students for 21st century and rising jobs, governments reserve big budgets for STEM education, especially for Race to the Top competition [7][42].

Despite STEM education being more demanding need for developed countries, the U.S. and European Union countries lead the way to promote STEM education. They aim to maintain sustainable economic growth. Before OECD report, as Dugger [27] mentions, STEM education was already supported in U.S. by many projects such as Technology for All Americans Project (1994-2005) and Standards for Technological Literacy: Content for the Study of Technology (2000-2007) which are funded by the National Science Foundation (NSB & NSF) [48]. In 2005 the report called Tapping America's Potential: Education for Innovation released by a group of technology and business initiatives [71], which shed lights on the actions to support STEM education such as building national support, increase motivation to enter STEM careers etc. Similar STEM education promotions projects which are funded by European Commission (EC) have been done in Europe as well. EC has aimed to increase interest in STEM education with many projects such as Promise, Roberta-EU, Update, Profiles, Pathway, Fibonacci, Parsel, S-TEAM, Engineer in between 2002-2006; Horizon 2020 in between 2014-2020 [31][32][33]. Through these projects, STEM education has been carried out to all Europe coordinately.

Likewise in Turkey, with the support of projects which are funded by EC, The Scientific and Technological Research Council of Turkey, or by other collaborations, STEM education activities has accelerated within the last decade so that show big leap in the STEM areas [1][2][3][37][66]. In case of implementation of STEM activities in Turkey, unfortunately, it changes according to school type so that a small percentage of students have chance to access STEM education at international standards [17]. PISA results revealed that 68.7% of the students in Turkey belong to low socio-economic and cultural group so they have limited access to quality educational resources and programs [50]. That's why, in Turkey, educating students to be STEM literate is the main concerns of the national curricula because there is a need to provide STEM education opportunities to disadvantaged students through formal education programs. Integrated STEM education programs are needed to train students as STEM literate individuals who can solve real life problems. STEM related studies in Turkey, generally emphasize the context integration model [13][68]. However, there is a need to practice content integration model that brings STEM education disciplines together in a unit or within an activity. In order to meet this need, the national curricula revised in 2017 so that, as Moore et.al [46] explain, students participate in engineering design as a means to develop technologies that require meaningful learning and an application of mathematics and science. STEM integration in the classroom is not just a type of curriculum integration which consists of simply putting different subject areas together. The concept of curriculum integration is more complex and challenging than bringing four disciplines together because the idea of curriculum integration is rooted in educators' awareness that real world problems cannot be separated into isolate disciplines that are taught in schools [5][19][41]. There is not a single approach to integrating STEM [8][9][28][39][43]. However, Moore et al. [46] revealed a framework for integrated STEM education, which based on composition of different frameworks: a) a motivating and engaging context, (b) an engineering design challenge, (c) opportunity to learn from failure through redesign, (d) the inclusion of math and/or science content, (e) student centered pedagogies, and (f) an emphasis on teamwork and communication. Providing education for students who want to pursuit STEM-related careers become challenging for educators because teachers are expected to adapt their teaching practices to this ambitious educational reform.

1.1.2 Teachers' Conceptualization of STEM Education

There has been increased interest in integrated studies in STEM fields to better prepare students to solve 21st century problems that require interdisciplinary knowledge [6]. Ministry of education of countries around the world proposed policies on the reconstruction of curriculums via integrated interdisciplinary STEM learning. They declared the necessity and importance of STEM education in the national curriculums to ensure direct integration to the lesson plans. Since then, MOEs have made concentrated efforts to encourage successful implementation of STEM education in schools.

Despite such efforts, education authorities have little awareness about how STEM education is implemented in school, actually. The main reason behind it is the fact that there is lack of information about how teachers, as a key stakeholder, value and implement STEM education in schools. Despite the governments' focused interest in STEM education, roles, responsibilities and required teacher trainings has not been well established yet [62][63]. As Bybee [9] stated, it is important that stakeholders of STEM education have their own understanding of STEM education in order to better manage it local level. However, this situation causes difficulties for teachers because STEM education understanding of teacher might differ on personal and practical level.

Besides skills that cut across the four disciplines, STEM education requires skills and abilities which are different from traditional practices such as sharing responsibilities with students in classroom management and collaborating with other teachers from different fields [38][53][74]. However, many teachers feel insufficient to teach STEM. As Ward and Lee [74] say, although some of the teachers know theoretical part of requirements of STEM education, their practical experience is not enough; that's why, some precautions need to be taken to support teachers. New or adapted teaching strategies that simulate real-world situations may be required to gain new experience in teaching integrated STEM programs. Effective professional development enable teachers to gain necessary pedagogical skills to teach STEM, which will eventually affect STEM learning experiences of students [12]. There have been many STEM related studies [12][20][21][35][55][75] which looks relations between STEM teaching skills and experiences of teachers and students' STEM learning performance. Results of the studies revealed that inefficient taught STEM education have negative effect on students' performance because students learned more from qualified educators who have sufficient pedagogical knowledge. Thus, effective personal development have extreme importance for teachers in order them to adapt their teaching skills to STEM education which is in the focus of 21st century's educational reforms. Online environment [22], heterogeneous groups [15][16], self-evaluation bases [26][36][76], and collaborative professional learning communities [29][72] revealed as ways of providing effective sustainable professional development for teachers.

Beside the effectiveness of professional development and teacher content knowledge [40][44][47][54][64], as Ring et al. [57] explain, teachers' views, attitudes and readiness affect adaptability of teachers to the required skills and abilities of STEM education. Previous studies revealed that teachers' attitudes and views, which can identify teachers' understanding of their role in students' learning process [56], affect classroom practices in STEM related courses of students [30][45][58]. Although there are few researchs [73] that explore teachers' attitudes and views, they revealed that teachers' negative attitudes and views are sign of their low readiness regarding knowledge and understanding. By taking this situation into consideration, as Stohlman, Moore and Roehrig [67] said, the probability of teachers using STEM education in classroom is small.

Based on the gap in the literature which is lack of researches which try to reveal teachers' attitudes, views and readiness to adapt their teaching skills to STEM education, the aim of the present study is to reveal in-service science teachers' attitudes, views and readiness for STEM education.

1.2 Objective of the Thesis

The aim of this present study was to reveal in-service science teachers' attitudes, views and readiness for STEM education. The main goal was to investigate minds of in-service science teachers by deeply analyzing what they are implementing or planning to do in their lessons. Also, with current study, it is aimed to investigate the factors which help and hinder STEM implementation ability of in-service science teachers.

1.3 Hypothesis

Present study was conducted as a qualitative research; that is why, in the following the research questions presented instead of hypothesis. In an attempt to realize objective of the research, following research questions have arisen:

1- What are the attitudes of in-service science teachers towards STEM education?
2- What are the readiness of in-service science teachers towards STEM education?
3- Do these attitudes and readiness effect implementation of STEM education?
4- What are the views of in-service science teachers towards STEM education?

2
Framework of the Study

In this section, the framework of the research explained.

Teachers are the main shareholder of the education system. It is generally accepted that the competencies of the teachers decides the quality of the education. This quality plays an important role in improving students' commitment and success. Because of the required skills of 21st century, students need new knowledge and competencies to be successful individuals and citizens. In order to adapt education systems to 21st century's requirements, reforms have made in curriculums. However, these reforms requires teachers with professional attributes, knowledge and practice in order to carry out these reforms.

The Competency Framework for Teachers provides guideline to teachers in order to prepare them for 21st century's requirements. The framework presents professional attributes, knowledge and practice for teachers at the different stages of their profession. It provides benchmarks within the concepts of attributes, knowledge and practice which can be assessed throughout the teachers' professional development.

The Competency Framework for Teachers [24] described professional knowledge, skills and attributed that is required for in-service teachers. These competencies may adjust according to specific topics and contexts. Five dimensions of teachers' work, whose integration makes teaching more effective, border the competency standards. Phases in the framework are not symbols of the years of work experience, they symbolize the professional achievement and capacity. Professional capacity of teachers develops non-linearly. It happens through working in different contexts and working with different profiles. Besides these, there are some other customized attributes that everyone who wants to enter teaching profession should have. This framework guides shed light on teachers' professional development journey. The researcher presented the framework in Figure 1.

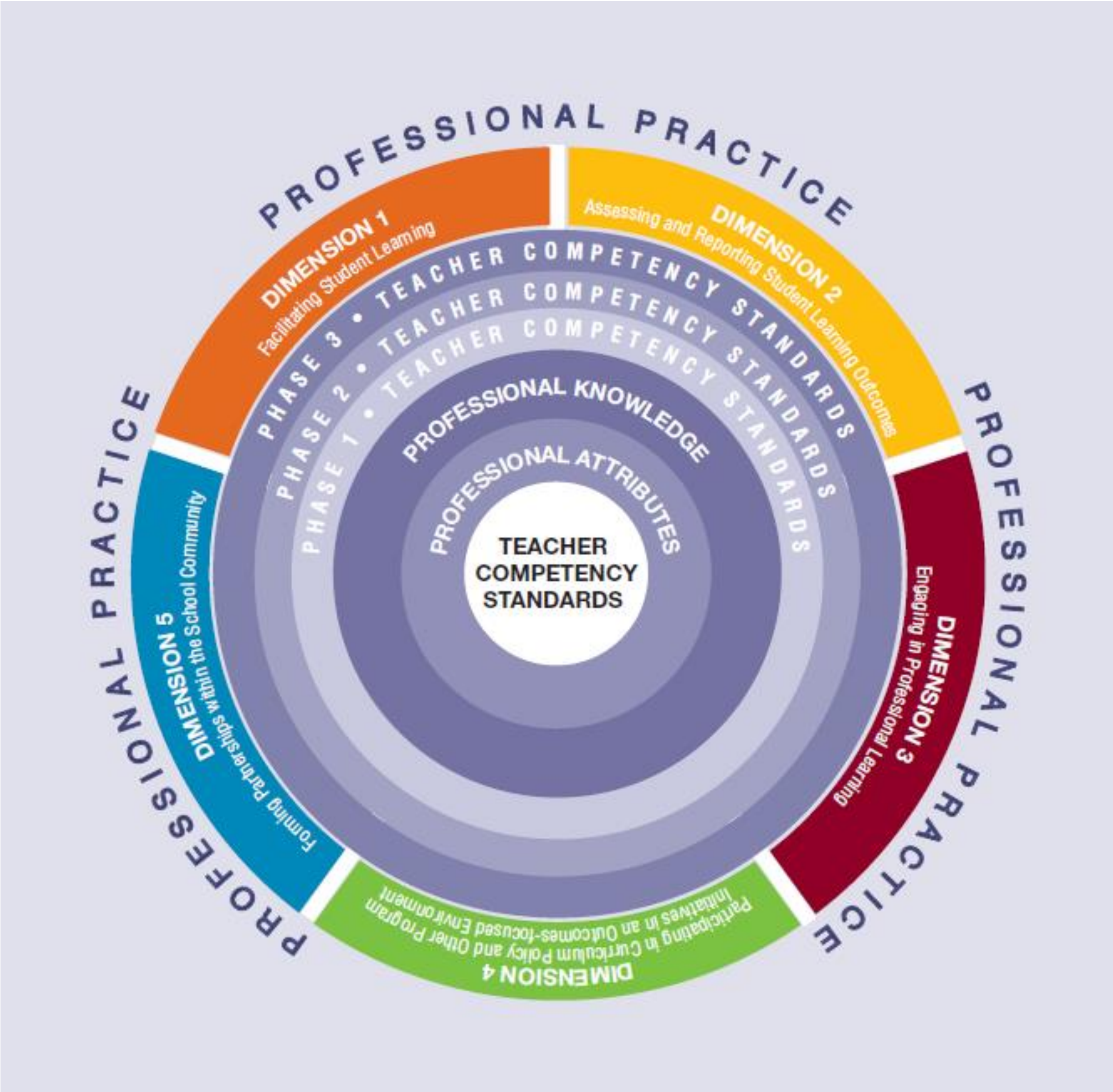

Figure 1 The Competency Framework for Teachers [24]

The framework consists of several components. It standardized competencies for effective teaching through three phases, which describes development of teachers' work. These phases are not based on the length of experience, they have dynamic structures. Regarding dimensions of teachers' work, there are five dimensions, which define general features of teaching profession with the focus of professional effectiveness. The part, which is called as competency standards, describes effective usage of professional knowledge and skills within the workplace context.

Professional attributes are the features that are compulsory for effective teaching. These attributes prepare teachers for every topic, every context, every challenge and obligations of teaching profession. The framework also describes relationship between shareholders of education such as teachers, students, parents so on. Professional attributes include attitudes, readiness, skills and values of teachers. Professional attributes to ensure effective teaching through every step of teaching profession is like as follows:

Figure 2 Professional Attributes of Effective Teaching [24]

Professional practices are the actions that are symbols of competency-related professional behaviors. These practices carry teachers to next competency standard. Professional practices to ensure effective teaching is like following:

	PHASE 1 Teachers operating within the first phase should:	PHASE 2 Teachers operating within the second phase should:	PHASE 3 Teachers operating within the third phase should:
DIMENSION 1 **Facilitating Student Learning**	Engage students in purposeful and appropriate learning experiences	Cater for diverse student learning styles and needs through consistent application of a wide range of teaching strategies	Use exemplary teaching strategies and techniques that meet the needs of individual students, groups and/or classes of students in a highly responsive and inclusive manner
DIMENSION 2 **Assessing and Reporting Student Learning Outcomes**	Monitor, assess, record and report student learning outcomes	Apply comprehensive systems of assessment and reporting in relation to student attainment of learning outcomes	Consistently use exemplary assessment and reporting strategies that are highly responsive and inclusive
DIMENSION 3 **Engaging in Professional Learning**	Reflect critically on professional experiences in order to enhance professional effectiveness	Contribute to the development of a learning community	Engage in a variety of learning activities that promote critical self reflection and the development of a learning community
DIMENSION 4 **Participating in Curriculum Policy and Other Program Initiatives in an Outcomes-focused Environment**	Participate in curriculum policy and program teamwork	Provide support for curriculum policy or other program teams	Provide leadership in the school by assuming a key role in school development processes including curriculum planning and policy formulation
DIMENSION 5 **Forming Partnerships within the School Community**	Establish partnerships with students, colleagues, parents and other caregivers	Support student learning through partnerships and teamwork with members of the school community	Facilitate teamwork within the school community

Figure 3 Professional Practices of Effective Teaching [24]

As a result, the Competency Framework for Teachers creates basic benchmarks for defining the professional attributes, knowledge and practice in the fields that a teacher should have. It also guides the policies to be developed in this field. In addition to defining and developing the content of theoretical and practical courses in the curriculums of universities, the qualifications that teachers need for professional development can be determined in a concrete way. In addition, the hiring process can be organized in accordance with the qualifications. On the other hand, in-service teachers can see their own strengths and weaknesses that need to be developed objectively. Therefore, teachers can be more motivated to develop themselves and to take responsibility for continuous professional development.

Furthermore, through an objective performance evaluation system based on competences, the current situation of each teacher can be analyzed objectively and accordingly, more qualified personal and professional development opportunities can be provided. It also provides chance to develop all policies related to education system and the teachers in a holistic and expedient way. This will then lead to the development of the trust and ethics of teachers as well as the social status of the teaching profession. Thus, the effective cooperation of all stakeholders in the process of teacher training ensures teachers that meet requirement of the 21st century.

Competency framework for teachers that is a tool used as conceptual framework for the present study. In the light of parts of this framework, collected data were analyzed. According to parts of frameworks, in-service science teachers' attitudes, readiness and views were interpreted.

3
Methodology

In this section, the methodology of the research explained. The methodology part composed of research design, research participants, data collection instruments, data collection process, data analysis process, trustworthiness and research permission and ethical consideration.

3.1 Research Design

As a research design of present study, the researcher used mixed research method in which the researcher uses mixture of quantitative and qualitative data in single study [18]. As Denzin [23] pointed out quantitative research assists the qualitative research by providing baseline information. Beside this, qualitative data interprets, clarifies and validates quantitative data.

In the quantitative part of present study, survey research design was used. In this design, researcher collects quantitative data using questionnaires to examine beliefs and attitudes of individuals about target concept. In case of present study, the researcher used survey research design to examine in-service science teachers' attitudes and readiness about STEM education. The collected quantitative data provided baseline information for qualitative part of the present study.

In the qualitative part of present study, phenomenology was used as a research design. Phenomenological research is a qualitative research method that focuses on comparing and contrasting the reflections of a homogenous group of people who have all experienced the same or similar events [22]. In case of present study, researcher collects qualitative data using interviews to examine views of in-service science teachers' attitudes and readiness about STEM education. The collected qualitative data validates and clarifies quantitative part of the present study. The mixed research design helped to examine perspectives of in-service science teachers' by revealing their way of interpreting their experiences regarding STEM education and way of attributing meaning to these experiences.

3.2 Research Participants

The participant group of the study consisted of 80 in-service science teachers and who are familiar with STEM education. Target group of the research differed regarding age, gender, educational backgrounds, work experience and work places. The participant group included 20 (25%) male and 60 (75%) female in-service science teachers between the ages of 22-41 who have different work experiences. The details of the demographic information are shown in the Table 1.

Table 1 Details of participants' demographics

Participant's Coded Name	Gender	Age	Latest Educational Degree	Workplace Type (School)	Work Experience (Years)	Previous STEM Training	STEM Education Usage in Lessons
1	F	26	MA	Private	0-1	YES	YES
2	F	26	MA	Public	2-5	NO	NO
3	F	28	BA	Public	2-5	NO	NO
4	F	31	BA	Public	6-10	NO	NO
5	F	26	MA	Public	2-5	NO	NO
6	F	28	BA	Public	2-5	NO	YES
7	F	30	BA	Public	2-5	NO	YES
8	F	27	BA	Public	2-5	NO	NO
9	F	24	MA	Public	0-1	NO	NO
10	M	32	MA	Public	6-10	YES	YES
11	M	30	PhD	Public	6-10	NO	NO
12	M	39	BA	Private	+16	YES	YES
13	F	25	MA	Public	2-5	NO	YES
14	F	32	PhD	Public	6-10	YES	YES
15	F	25	BA	Public	2-5	NO	NO
16	F	25	BA	Public	2-5	NO	NO
17	F	30	BA	Public	2-5	NO	NO
18	F	27	MA	Public	2-5	YES	NO
19	F	28	BA	Public	6-10	NO	NO
20	F	22	BA	Public	0-1	YES	NO
21	F	25	MA	Private	2-5	NO	YES
22	F	33	MA	Public	11-15	NO	NO
23	F	27	MA	Public	2-5	YES	NO
24	M	33	PhD	Public	6-10	NO	NO
25	F	29	BA	Private	6-10	NO	NO
26	F	41	BA	Public	+16	YES	YES
27	M	31	MA	Public	6-10	YES	YES
28	M	29	BA	Public	6-10	NO	YES
29	M	32	MA	Public	11-15	NO	YES
30	F	25	BA	Public	2-5	NO	NO
31	M	29	MA	Public	2-5	YES	YES
32	F	31	MA	Public	2-5	YES	NO

33	M	29	BA	Public	2-5	YES	YES
34	F	39	BA	Public	6-10	NO	NO
35	F	24	MA	Private	2-5	YES	NO
36	M	30	MA	Public	6-10	NO	NO
37	M	39	MA	Public	+16	NO	NO
38	F	35	BA	Public	11-15	NO	NO
39	F	35	MA	Public	11-15	NO	NO
40	F	23	BA	Public	2-5	NO	NO
41	F	28	MA	Public	2-5	NO	NO
42	M	34	BA	Public	11-15	NO	NO
43	F	40	BA	Public	+16	NO	YES
44	F	26	MA	Public	2-5	NO	NO
45	M	35	BA	Public	6-10	YES	YES
46	M	31	BA	Public	6-10	NO	NO
47	F	27	BA	Public	2-5	NO	NO
48	M	26	BA	Private	2-5	NO	NO
49	F	25	BA	Private	0-1	YES	YES
50	F	25	MA	Private	0-1	NO	NO
51	F	40	BA	Private	6-10	NO	NO
52	F	24	MA	Public	2-5	YES	YES
53	F	25	MA	Public	0-1	NO	NO
54	F	25	MA	Private	2-5	NO	NO
55	F	26	MA	Public	0-1	NO	NO
56	M	33	MA	Private	2-5	NO	NO
57	F	36	MA	Private	6-10	NO	YES
58	F	24	MA	Private	0-1	YES	YES
59	F	27	MA	Private	2-5	NO	NO
60	F	25	BA	Private	2-5	YES	YES
61	M	30	BA	Public	6-10	NO	NO
62	F	31	BA	Public	6-10	NO	NO
63	M	28	BA	Public	2-5	NO	NO
64	F	26	MA	Public	0-1	NO	NO
65	F	25	MA	Private	0-1	NO	YES
66	F	37	BA	Public	11-15	NO	NO
67	F	29	BA	Public	2-5	NO	NO
68	F	26	BA	Public	2-5	NO	YES
69	M	32	MA	Public	6-10	NO	NO
70	F	25	BA	Private	2-5	NO	NO
71	F	27	BA	Private	2-5	NO	YES
72	F	25	BA	Private	2-5	NO	NO
73	F	24	BA	Public	2-5	NO	NO
74	F	25	BA	Public	0-1	NO	NO
75	M	31	BA	Public	2-5	NO	NO
76	F	25	BA	Public	0-1	NO	NO
77	F	26	BA	Public	2-5	NO	NO
78	F	24	BA	Public	2-5	NO	NO
79	F	27	BA	Public	2-5	NO	NO
80	F	26	BA	Private	2-5	NO	NO

The summary of the participants' demographic were shown in the Table 2. The table shows that 75% of the participants were female, 25% of the participants were male, 56.3% of the participants have BA degree, 43.8% of the participants have MA or PhD degrees, 75% of the participants work in public schools, 25% of the participants work in private schools and majority of the participants (50%) have 2-5 years of work experience.

Table 2 Descriptive data of participants

	Number(#)	***Percentage(%)***
Gender		
Female	*60*	*75*
Male	*20*	*25*
Latest Educational Degree		
Undergraduate	*45*	*56.3*
Graduate	*35*	*43.8*
Workplace Type (School)		
Public	*60*	*75*
Private	*20*	*25*
Work Experience (years)		
0-1	*12*	*15*
2-5	*40*	*50*
6-1	*18*	*22.5*
11-15	*6*	*7.5*
16+	*4*	*5*

In case of STEM training and STEM education usage of participant group, descriptive statistics (Table 3) showed that 22.5% of the participants got STEM training and 30% of the participants use STEM education in their lessons. These results indicated that some of in-service science teachers use STEM education in their lessons without having training about it.

Table 3 STEM education summary of participants

Previous STEM Training	***Number(#)***	***Percentage(%)***
NO	*62*	*77.5*
YES	*18*	*22.5*
STEM Education Usage in Lessons		
NO	*56*	*70*
YES	*24*	*30*

These participants were chosen among in-services science teachers by purposeful, snowball and convenience sampling method which was used because of participants' convenient accessibility to the author of the thesis. Farrokhi and Mahmoudi-Hamidabad [34] explained convenience sampling as a way of sampling the members of target population if they meet already determined criteria of the researcher align with the aim of the study such as availability at easy accessible time.

3.3 Data Collection Instruments

The present study was carried out with two parts. In the first part, to describe attitudes and readiness of in-service science teachers, T-STEM survey was used as data collection tool because surveys can be useful when a researcher wants to collect data on phenomena that cannot be directly observed. Before the survey, the researcher added some questions to gather demographic information of the participants. t-STEM survey which consist of 9 parts developed by Friday Institute for Educational Innovation (2012), translated to Turkish by Taş, Yerdelen & Kahraman [69]. Each part invited teachers to give information about their self-efficacy for teaching, their belief that teachers affect student learning, how often students use technology, how often they use certain STEM instructional practices, their attitudes toward 21st century learning, their attitudes toward teacher leadership and their awareness of STEM careers. The survey is five point Likert Type scale and each statement were labeled as 5=strongly agree, 4=agree, 3=undecided, 2=disagree and 1=strongly disagree. In order to measure reliability and validity of the survey, two confirmatory factor analyses (CFA) were conducted using LISREL 8.8 (Jöreskog & Sörbom, 2007): (1) for all subscales other than Student Technology Use (n=324) and (2) for Student Technology Use by removing N/A respondents (n= 225). The first CFA results indicated good model fit for the proposed eight factor structure (S-RMR= 0.065, CFI= 0.959, NNFI= 0.957, IFI= 0.959). The second CFA was conducted with Student Technology Use items and fit indices supported that the data fit well to the proposed one factor structure (S-RMR= 0.052, CFI= 0.929, NNFI= 0.901, IFI= 0.930) [69]. In Appendix-A, the researcher presented the t-STEM survey.

In the second part, to reveal views of in-service science teachers, semi-structured interviews were used as data collection tool. After analyzing related literature, framework of the study and the quantitative data of the study, the researcher created interview protocol with 6 questions. During construction process of the interview questions, the advisor of the present study who is an expert on STEM education guided process from expert point of view. Also, the researcher got opinions of other researchers who work on the similar topic. In Appendix-B, the researcher presented the interview protocol.

In order to answer research questions of the present study, in the Table 4, the researcher shared the connections between data collections tools and research questions.

Table 4 Research questions and data collection tools

<table>
<tr><th>Research Questions</th><th colspan="2">Data Collection Tools</th></tr>
<tr><td></td><td colspan="2">t-STEM Questionnaire</td></tr>
<tr><td rowspan="3">1-What are the attitudes of in-service science teachers towards STEM education?</td><td>Part 2</td><td>Science teaching outcome expectancy</td></tr>
<tr><td>Part 4</td><td>Mathematics teaching outcome expectancy</td></tr>
<tr><td>Part 8</td><td>Teacher leadership attitudes</td></tr>
<tr><td rowspan="3">2-What are the readiness of in-service science teachers towards STEM education?</td><td>Part 1</td><td>Science teaching efficacy and beliefs</td></tr>
<tr><td>Part 3</td><td>Mathematics teaching efficacy and beliefs</td></tr>
<tr><td>Part 9</td><td>STEM career awareness</td></tr>
<tr><td rowspan="3">3-Do these attitudes and readiness effect implementation of STEM education?</td><td>Part 5</td><td>Student technology use</td></tr>
<tr><td>Part 6</td><td>Elementary STEM instruction</td></tr>
<tr><td>Part 7</td><td>21st century learning attitudes</td></tr>
<tr><td>4-What are the views of in-service science teachers towards STEM education?</td><td colspan="2">Interviews</td></tr>
</table>

3.4 Data Collection Process

This mixed research study aimed to examine in-service science teachers' attitudes, views and readiness for STEM education. As it was stated before, survey research design and phenomenology was selected as the most appropriate research designs for data collection and analysis processes of the study.

The data from the t-STEM questionnaire was collected via online platform. First, consent form and demographic information form were filled in by the participants before the survey. The questionnaire was distributed in the period between November 2017 and December 2017, to the 80 in-service science teachers in Istanbul. Filling in the questionnaire was voluntary and took approximately 20 minutes.

The qualitative data was collected through face-to-face semi-structured interviews that were created by the researcher. This interview protocol allow participant to reflect on and explain his/her personal perspective on STEM education. After the quantitative data collected, the researcher chooses 10 participants among 80 participants who completed the t-STEM questionnaire, conveniently and purposefully. Interviews hold after planning with those who accept to be included in the study. Each interview session took approximately 20-25 minutes.

3.5 Data Analysis Process

In the data analysis part, the researcher analyzed the collected data looking for significant statements that explains in-service science teachers' attitudes, views and readiness for STEM education.

First part of the data analysis focused on quantity and relation of in-service science teachers' responses to each part of the t-STEM survey. That means, it was determined that the parts were understood or not, by looking at the number of the participants' answers and whether the answers were coincident with other parts or not. At this point, different parametric tests such as t-test and one-way analysis of variance (ANOVA) were used in analysis of the obtained data from the survey based on p=0.05 significance level that were used to clarify the significance of the differences on means. All statistical analyses were conducted using the program SPSS.

Before proceeding to the analyzes to be carried out for the purpose of the study, it was tested whether the data obtained from the participants were in accordance with the basic assumptions of parametric statistics. For this purpose, firstly, whether the responses of the participants to the questionnaire and scale questions were entered correctly on the computer and whether there were missing values were examined with various sub-programs of SPSS 21 statistical package program. Then, it is examined whether multiple parametric statistics meet some assumptions such as normality, covariance and linearity [68]. The z values of the variables were calculated so that the extreme values in the data were not detected and included in the analysis. Considering this coefficient ($-3.29 > z < 3.29$), no excessive value was found in the data obtained from the participants. Thus, analyzes were continued using the data of 80 people.

As a second part of the data analysis, after conducting all the interviews with participants, responses from the participants were transcribed. Then the analysis process continued in six steps, as it is suggested by Smith et al. [65]. First, all transcripts were read and listened to be able to have comprehensive knowledge of the data. In the second steps, in order to gain insight into perspective of participants about the phenomenon, the researcher added descriptive comments which include initial notes and significant quotes. Then, for the third step, responses were coded to create main themes which indicate answers of the research questions with the help of previous descriptive comments. In fourth and fifth steps, the researcher tried to reveal connections and patterns in each response of the participants by codes in order to create common themes. At the final step of the analysis, researcher created patterns and themes among responses of the all participants. By concluding this process, the structural and contextual descriptions of perspective of the participants revealed [18]. At the end of the analysis, researcher mixed the both part of the data analysis and showed connections between analyzes of the collected data and research questions.

3.6 Trustworthiness

In order to ensure trustworthiness of the data analysis, triangulation method was used in the present study. As Denzin [23] stated triangulation means combination of one or two perspectives, theories, sources or opinions in order to clarify and validate understanding of researcher.

In the present study, two other researcher who work on the similar topic coded interview transcripts independently. Then the researchers compare all codes and caught consistency by discussing differences with other researchers until consensus was reached.

On the other hand, comparisons of gathered data from two part of the present study provide credibility of the study. Quantitative data compose baseline findings of the data and qualitative data clarifies and validates this quantitative data, which eventually ensure credibility of the study.

Beside these, transcribed data shared with the participants to ensure that there is not any missing point or misunderstanding during the transcription process.

3.7 Research Permission and Ethical Consideration

Through the thesis process, all participation was strictly based on a voluntary basis so that the participants are informed and protected. The ethical treatment of the participants' data was considered throughout the design and continuum of the study. The participants are able to drop out at any time by leaving the study. Also, incomplete surveys are not included in the study.
While using the t-STEM questionnaire, required permissions received from the Taş, Yerdelen & Kahraman [69] who translated the questionnaire in Turkish. In Appendix-C, the researcher presented the permission e-mail.

4
Result & Discussion

This chapter presents collected information related to research questions. The findings from data analysis were presented in accordance with the research questions. The collected data analyzed under the main focus of in-service science teachers' attitudes, views and readiness for STEM education. In order to understand mindset of in-service science teachers questionnaires were filled in and interviews were done. The responses of the participants to interview questions were translated to English while quoting. Also, due to ethical issues, names of the participants are coded. The combination of these data created deeper understanding of the in-services science teachers' perspective on STEM education. In this part, each finding was represented under related research questions. Each research questions were discussed within the scope of related survey parts and interview questions.

4.1 Descriptive Statistics

The participant group of the study consisted of 80 persons who are in-service science teachers. The participant group included 20 (25%) male and 60 (75%) female in-service science teachers between the ages of 22-41 (mean age = 28.89) who have different work experiences.

Effect of gender

Independent samples t-test was applied to the data obtained in order to determine whether the scores obtained from the subscales of STEM questionnaire differed according to gender. When the results of the analysis were examined, it was seen that the scores of the male and female participants for each subsection did not differ ($p > .05$).

Effect of educational background

Independent samples t test was applied to the data obtained in order to determine whether the scores obtained from the subscales of the STEM questionnaire differed according to the educational background variable. When the results of the analysis were examined, it was seen that only the scores obtained in the ninth subsection of the questionnaire differed according to the level of education [t (78) = -2.61, p <.05]. According to this, the average score of the participants with a bachelor's degree in the ninth part was found to be significantly lower than that of the participants with a graduate level of education. This means readiness of participants with bachelor degree was found to be significantly lower than that of the participants with a graduate level of education. Information on this result was presented in Table 5.

Table 5 Effect of educational background

Variables	N	Mean	Sd	df	t	p
T-STEM Survey						
9th subscale						
Undergraduate	45	11.18	4.73	78	-2.61	0.01
Graduate	35	13.89	4.42			

Effect of workplace type (school)

Independent samples t-test was applied to the data obtained in order to determine whether the scores obtained from the subscales of STEM questionnaire differed according to the type of workplace (private school and public school). When the results of the analysis were examined, it was found that the scores obtained from the subscales of the participants did not differ according to their studies in public or private schools (p> 0.05).

Effect of having previous STEM training

Independent samples t-test was applied to the data obtained in order to determine whether the scores obtained from the subscales of STEM questionnaire differed according to whether they had received STEM training before. When the results of this test were examined, it was seen that the scores of the participants differed only in the ninth subsection of the STEM questionnaire subscale [t (41.1) = -4.26, p <.05]. Accordingly, the mean scores of the participants who received STEM training from the ninth part of the questionnaire were significantly higher than those of those who did not have STEM training. However, Levene's Test results showed that the variances were not homogeneous (p <0.05). A significant difference between the number of people in the two groups (with and without STEM training) compared should be taken into account when evaluating the results. Information on the results of this analysis was presented in Table 6.

Table 6 Effect of having previous STEM training

Variables	**N**	**Mean**	**Sd**	**df**	**t**	**p**
T-STEM Survey						
9th subscale						
Without training	62	11.44	4.76	41.1	-4.26	0.001
With training	18	15.56	3.20			

Effect of STEM education usage in lessons

Independent samples t-test was applied to the data obtained in order to find out whether the scores obtained from the subscales of STEM questionnaire differed according to whether they used to teach before using STEM or not. When the results of this test were examined, it was seen that the scores of the participants differed only in the ninth subsection of the STEM questionnaire subscales [t (41.1) = -3.02, p <.05]. Accordingly, the mean scores of the participants who had previously taught using STEM from the ninth subsection of the questionnaire were significantly higher than those of those who had not taught using STEM. Levene's Test results showed that the variances were not homogeneous (p <0.05). This should be considered when examining the results. Information on the results of this analysis can be examined in Table 7.

Table 7 Effect of using STEM education in lessons

Variables	N	Mean	Sd	df	t	p
T-STEM Survey						
9th subscales						
Not using STEM Education	56	11.46	4.94	58.44	-3.02	0.01
Using STEM Education	24	14.46	3.64			

4.2 Results of Inferential Data Analysis

Pearson Product-Moment Correlation analysis was conducted to investigate the relationships between the sub-dimensions of STEM questionnaire, age and professional experience variables. Correlation analysis can be examined in Table 8. As it seen in the table, science teaching efficacy and beliefs has positive and meaningful correlation with science teaching outcome expectancy (r=.54, *p*<.01), mathematics teaching efficacy and beliefs (r=.23, *p*<.05), mathematics teaching outcome expectancy (r=.26, *p*<.05), students' technology use (r=.38, *p*<.01), elementary STEM instruction (r=.56, *p*<.01), 21st century learning attitudes (r=.34, *p*<.01), teacher leadership attitudes (r=.58, *p*<.01) and STEM career awareness (r=.35, *p*<.01). Similarly, science teaching outcome expectancy has positive and meaningful correlation with mathematics teaching outcome expectancy (r=.49, *p*<.01), students' technology use (r=.32, *p*<.01), elementary STEM instruction (r=.47, *p*<.01), 21st century learning attitudes (r=.41, *p*<.01) and teacher leadership attitudes (r=.43, *p*<.01).

On the other hand, mathematics teaching efficacy and beliefs has positive and meaningful correlation with only mathematics teaching outcome expectancy (r=.45, *p*<.01). According to Table 8, mathematics teaching outcome expectancy has positive and meaningful correlation with students' technology use (r=.27, *p*<.05), elementary STEM instruction (r=.30, *p*<.01), 21st century learning attitudes (r=.29, *p*<.01) and teacher leadership attitudes (r=.37, *p*<.01).

Table 8 Correlation coefficients between variables

Variables	1	2	3	4	5	6	7	8	9	10	11
1 Part 1	-										
2 Part 2	.54**	-									
3 Part 3	.23*	.12	-								
4 Part 4	.26*	.49**	.45**	-							
5 Part 5	.38**	.32**	.16	.27*	-						
6 Part 6	.56**	.47**	.17	.30**	.55**	-					
7 Part 7	.34**	.41**	.05	.29**	.25*	.40**	-				
8 Part 8	.58**	.43**	.18	.37**	.26*	.53**	.56**	-			
9 Part 9	.35**	.17	.03	.16	.23*	.40**	.24*	.29**	-		
10 Age	.14	.11	-.17	.11	-.04	-.02	.16	-.01	.02	-	
11 Exp.	.16	.07	-.16	.12	.01	.07	.16	.02	-.01	.84**	-

*p<0.05, **p<0.01

Students' technology use has positive and meaningful correlation with elementary STEM instruction (r=.55, *p*<.01), 21st century learning attitudes (r=.25, *p*<.05), teacher leadership attitudes (r=.26, *p*<.05) and STEM career awareness (r=.23, *p*<.05). Elementary STEM instruction has positive and meaningful correlation with 21st century learning attitudes (r=.40, *p*<.01), teacher leadership attitudes (r=.53, *p*<.01) and STEM career awareness (r=.40, *p*<.01). 21st century learning attitudes has positive and meaningful correlation with teacher leadership attitudes (r=.56, *p*<.01) and STEM career awareness (r=.24, *p*<.05). Teacher leadership attitudes has positive and meaningful correlation with STEM career awareness (r=.29, *p*<.01).

As it was stated before, science teaching outcome expectancy (Part 2), mathematics teaching outcome expectancy (Part 4) and teacher leadership attitudes (Part 8) were specified as “attitude” related parts of the t-STEM questionnaire; science teaching efficacy and beliefs (Part 1), mathematics teaching efficacy and beliefs (Part 3) and STEM career awareness (Part 9) were specified as “readiness” related parts of the t-STEM questionnaire; student technology use (Part 5), elementary STEM instruction (Part 6) and 21st century learning attitudes were specified as “attitudes and readiness effect on implementation” related parts of the t-STEM questionnaire. As it was stated above in, attitudes related parts of t-STEM questionnaire and readiness related parts of t-STEM questionnaire have positive and meaningful correlation with implementation of STEM education related parts of t-STEM questionnaire. Attitudes of in-service science teachers has positive and meaningful correlation with readiness of in-service science teachers (r=.58, p<.01). Implementation of STEM education has positive and meaningful correlation with attitude of in-service science teachers (r=.64, p<.01) and readiness of in-service science teachers (r=.93, p<.01). These correlations can be interpreted as if an in-service science teacher has a positive attitude and readiness, this teacher uses STEM education in his/her lessons. When Table 10 was examined, it was found that the attitudes and readiness of the participants about STEM significantly predicted the implementation of STEM. Attitude and readiness variables together account for 87% of the total variance (R^2 = .87, F (2.78) = 255.84, p <0.01). Relationships among attitude and readiness of in-service science teachers and implementation of STEM can be examined in Table 9 and Table 10.

Table 9 Relationships among attitude, readiness and implementation of STEM

Variables	**1**	**2**	**3**
1 Attitude	-		
2 Readiness	.58**	-	
3 Implementation	.64**	.93**	-

*p<0.05, **p<0.01

Table 10 Variables that predict STEM implementation

Variables	R	R^2	Beta	F	t
Attitude	.93	.87	.15	255.84	3.12**
Readiness			.84		17.12**

The reason why the variance is so high may be that attitude and readiness are sub-sections of the t-STEM survey. However, the researcher analyzed the collected data looking for significant statements that explains in-service science teachers' attitudes, views and readiness for STEM education. For the purpose of the study, it is expected to approach collected data inductively.

4.3 Results of Analysis of Codes and Themes

In order to understand views of in-service science teachers on STEM education and STEM integrated science curriculum, interviews done. The responses of the participants translated to English while quoting. The combination and analysis of responses created deeper understanding of mindset of in-service science teachers. Responses relating views of in-service science teachers on STEM education and STEM integrated science curriculum has been gathered through interview questions and combined. These combined responses coded. Then codes come together around two main themes which are definition of STEM and features of STEM learning resources. Frequency of the codes can be examined in Table 11.

It indicates responses of participants revolve around two main themes which are definition of STEM and features of STEM. Regarding definition of STEM education, 70% of in-service science teachers defined STEM education as an integrated disciplines. An example of participants' responses:

"STEM education is mixture of science, technology, engineering and mathematics." (Participant 22)

Table 11 Frequency table of codes

Themes	Codes	# of participants mentioned
Definition of STEM	Integrated disciplines	7
	Teaching approach	9
	Acronym	3
	Teamwork	5
	Design process	9
	Engineering	3
Features of STEM	Usable & Helpful	6
	Implementable in Turkey	6
	Science-based	8
	Project-based	9
	Not Implementable in Turkey	4
	Learnable	7
	Un-learnable	3
Total		10

90% of participants defined STEM as teaching approach to use in science lessons. The reason for this response might be the fact that participant group of the present study consist of in-service science teachers. Also, this definition might be a sign of in-service science teachers' perception regarding STEM because of the fact that they accept it as a compulsory that comes from new arrangements of the science curriculum. An example of participants' responses:

"STEM is the new teaching approach that we should use in our science classes because of the fact that it is integrated in the new science curriculum." (Participant 37)

30% of the participants defined STEM as an acronym that stands for Science, Technology, Engineering and Mathematics. This might be seen as a half-read definition, the reason for these responses might be the fact that when some of participants graduated, STEM education is not included to the teacher training curriculums. Also, because of the fact that they had many years of work experience, it might cause vocational blindness as a barrier to adapt new trends. An example of participants' responses:

"STEM is just an acronym that stands for science, technology, engineering and mathematics." (Participant 4)

90% of participants defined STEM as design process and 30% of participants defined STEM as engineering. Because of the fact that STEM is accepted as an project-based approach, majority of participants defined STEM as a design process. On the other hand, although engineering is one of the components of STEM, responses of participants intended to state STEM as a baseline for engineering profession, which might cause specialization of STEM education for engineering profession.

"STEM is a mixture of all sciences that are required for mainly become an engineer. You need to know science and mathematics and you need to use technology in order to be an engineer." (Participant 4)

There is not a wrong or right definition of STEM. Although there is widely accepted definitions like Capraro et al. [10][11] stated; as an interdisciplinary educational approach, STEM (Science, Technology, Engineering and Mathematics) encircles K-12 curriculum. STEM education should not be bordered with definition but expressed according to perspectives. That is why, it is expected to receive different definitions as responses.

Regarding features of STEM education, majority of participants described STEM as project-based education (90% of participants) and science-based education (80% of participants) defined STEM education as an integrated disciplines. An example of participants' responses:

"When I assigned the project to the students, I try to follow STEM education approach as much as I can. I first want my students to find real world problem and I want them to make brainstorming about the possible solutions. Then, I want them to visualize their solutions." (Participant 37)

"I try to explain scientific background of all topics. Because, I think, STEM approach is all about science. Technology, engineering and mathematics all of them are branches of science. That is why, I think, STEM means science." (Participant 51)

Although 70% of the participants think that STEM is learnable and they attend courses and workshops to learn STEM, 30% of the participants think it is not learnable. Even, the veteran in-service science teachers who are participants of the present study, although they spend many years in the profession, they still attend courses and workshops to learn STEM. Reason of this resistance to learn STEM might arise from their opinion, which is that STEM is not implementable in Turkey because of inefficient physical conditions, insufficient teacher education and high student population.

"I attended a workshop to learn STEM. It did not provide comprehensive knowledge but I learned its mindset. However, when I try to implement it in my classes, it was so hard to manage process. The time was not enough, number of students was high and we did not enough material to use. So, I think, unfortunately, STEM is helpful approach however it is not implementable in our country." (Participant 17)

When we took all the aforementioned analysis into consideration, it is emerged in the interviews that majority of the participants think STEM is useful and helpful approach to teach science, technology, engineering and mathematics to students. However, although they think it can be learnable, they think it is hard to implement in Turkey because of the circumstances.

4.4 Limitations of the Study

One of the most important limitations for the present study is, although STEM education has broader concept, focusing only in-service science teachers. This study could be conducted with in-service teachers from different fields. Also, in order to get more generalized results, it could be conducted with more people who are in-service teachers from different fields.

The other important limitation is gender distribution among participant group, which is not equal. The female participants are more in the present study. That is why, regarding generalization of results, male in-service science teachers should represented in the study.

5
Conclusions & Recommendations

In this chapter, the r**esults** of the research were summarized and discussed within the context of research questions of the study and related literature. Then, recommendations for further studies were presented.

5.1 Conclusion

The purpose of the study was to reveal in-service science teachers' attitudes, views and readiness for STEM education. Another goal was to investigate the factors that help and hinder STEM implementation ability of in-service science teachers. With using mixed research model, the study conducted into two parts. The first part handled through t-STEM questionnaire with 80 in-service science teachers. The second part handled through semi-structured interviews with 10 in-service science teachers. The participant group included 20 (25%) male and 60 (75%) female in-service science teachers between the ages of 22-41 who have different work experiences. The collected quantitative data processed with independent samples t test and ANOVA. The collected qualitative data processed with content analysis method.

Framework of the study was the Competency Framework for Teacher. According to it, there are some benchmarks in professional attributes, knowledge and practice in order to be called as competent teacher. When we look at the collected data regarding professional knowledge from the framework's perspective, we saw that professional knowledge of teachers about STEM vary from teacher to teacher and from school to school. Generally, it is expected to have consensus on professional knowledge; however, according to interviews, in-service science teachers do not have consensus on definition of STEM yet. Therefore, it is important for policy makers and education authorities to provide compromised knowledge on STEM education. By providing such training, professional knowledge of teachers about STEM may be aligned.

When we look from the perspective of professional attribute part of the framework to the collected data, it revealed that in-service science teachers have positive attitudes for STEM education and they ready to use it in their lessons. However, when we interpret data more comprehensively, it showed that because of lack in their professional knowledge, they do not have enough self-confidence to use STEM in their lessons.

In case of professional practice, collected data showed that in-service science teachers use STEM education in their lessons. However, they also stated that they are unsure of its effectiveness. Differences in their definitions of STEM and in their STEM implementations in lessons revealed that they do not have consensus on practice of STEM in lessons. When look at the collected data from the perspective of framework, it can be said that in case of benchmarks of professional knowledge, attributes and practice, in-service science teachers should show more progress. This conclusion revealed that in-service science teachers are still incompetent in case of STEM education.

In the present study, the researcher aimed to reveal in-service science teachers attitudes, readiness and views towards STEM education. In order to reach that aim, the researcher used t-STEM questionnaire and interviews. When the results took into considerations, it can be said that majority of participants have positive attitudes towards STEM education so that they thought that STEM approach should be learned and science, technology, engineering and mathematics should be used integratedly. The other reason of positive attitude is worldwide increased attention towards STEM and STEM's popularity as a new educational trend. In-service teachers' attitude is important for implementation of STEM education in lessons. Because of the fact that teachers are the main shareholder of the education, if the teachers actively use an approach, it can be easily accepted nationwide. Responses of interview questions showed that in-service science teachers reported positive intentions about using STEM in their future lessons because it is enjoyable to implement, develops collaborative learning skills and provides science based permanent learning and awareness.

The present study also revealed that, although there is common STEM education awareness among in-service science teachers who contributed the study, they do not have consensus on concept of STEM education. This shows that although in-service science teachers who contributed the study have readiness towards STEM, they might not conceptualize integrative concept of STEM. With the reform practices of Turkish MOE regarding STEM education, it was aimed to increase competencies of teachers and students in the fields of science, technology, engineering and mathematics and providing students learning experiences that will prepare them STEM related careers [65]. However, data captured through interviews showed that STEM workshops and courses give insights on STEM; however, in-service science teachers could not able to turn these insights into practice. The fact that how they should integrate STEM into their lessons still is not clear. It can be said that in–service science teachers' attitudes and readiness is ready to implement STEM in their lessons but they do not know how they should do it.

Data captured through interviews revealed that in-service science teachers see lack of materials and environment as a reason for not using STEM in their classes. However, despite limited resources, STEM inspires teachers and students to be creative and innovative [17]. In other words, contrary to general understanding STEM approach does not mean to teach already existing resources, it aims to inspire teachers and students to find innovative solutions with existing and non-existing resources to real life problems [11].

All in all, as in European countries, in Turkey the quantity and quality of STEM education should be increased. The result of the present study indicated that because of the fact that STEM is worldwide educational trend and STEM education integrated into Turkish science curriculum, in-service science teachers want to learn and use STEM in their future lessons. Although some of them know and use STEM already, they are still not reached consensus among each other about meaning and practice of STEM. That is why, although in-service science teachers have positive attitude and readiness towards STEM education, they still need to learn how to implement STEM in their lessons. Integrating STEM into Turkish science curriculum before in-service science teacher have teacher development program for

STEM education seen as an unprepared decision. That is to say, needs analysis should be carried out to detect required trainings and teacher development journey for STEM education should prepared.

5.2 Recommendations

First of all, for further studies, there are several recommendations to re-do this study by addressing some of the previously stated limitations. For example, this study could be conducted with in-service teachers from different fields. Also, in order to get more generalized results, it could be conducted with more people who are in-service teachers from different fields.
Besides these, as it is stated earlier, variance value was high and one of the reasons of it was variables being the parts of same questionnaire. That is why, attitudes and readiness of in-service science teachers can be measured with different data collection tools.

As another suggestion, detailed qualitative part can be added instead of the present interview protocol to make responses to questionnaire more meaningful. Investigating reasons beneath responses in quantitative part could reveal more accurate, deeper insights regarding in-service science teachers' attitudes, readiness and views.

A

t-STEM Survey

İsim:

İletişim Bilgisi (e-mail/GSM):

Cinsiyet:

Yaş:

Branş:

Mezun olduğunuz üniversite:

- Lisans: ______________________________________

(Ders Aşamasında / Tez Aşamasında / Mezun)

- Yüksek Lisans: _________________________________

(Ders Aşamasında / Tez Aşamasında / Mezun)

- Doktora: ____________________________________

(Ders Aşamasında / Tez Aşamasında / Mezun)

Çalıştığınız Kurum:

- Özel Okul • Devlet Okulu

Mesleki Deneyiminiz:

- ________ay
- ________yıl

Hangi sınıf düzeyine ders veriyorsunuz?

Daha önceden aldığınız ya da şu an devam eden STEM eğitiminiz var mı?

Evet Hayır

STEM eğitimi aldıysanız ya da alıyorsanız, aldığınız bu eğitimin

-Süresi:

-İçeriği:

Ders işlerken kullandığınız yöntem ve teknikler nelerdir?

Daha önceden STEM kullanarak ders işlediniz mi?

Sayın Öğretmenim,

Bu anket, **Fen, Teknoloji, Mühendislik ve Matematik (FeTeMM)** Eğitimi ile ilgili 9 bölümden oluşmaktadır. Bu çalışmanın amacı, FeTeMM eğitiminin Türkiye'deki durumunu tespit etmektir. Bu yüzden sizin vereceğiniz yanıtlar oldukça önemlidir. Lütfen, her bir ifadeye ne derece katıldığınızı ya da katılmadığınızı belirtiniz. Bazı ifadeler birbirine benzer olsa bile lütfen her ifadeyi yanıtlayınız. Ankette "Doğru" ya da "Yanlış" cevap yoktur. Mümkün olduğunda maddelere yanıt verirken başınızdan geçen olayları göz önüne alınız. Katkılarınız için teşekkür ederiz.

1. **Aşağıda fen öğretimi ile ilgili bazı ifadelere yer verilmiştir. Bunları kendi öğretiminizi yansıtacak şekilde işaretleyiniz.**

		Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1	Fen öğretimi uygulamalarımı sürekli geliştiriyorum.	1	2	3	4	5
2	Fen bilimlerini etkili bir şekilde öğretmek için gerekli adımları biliyorum.	1	2	3	4	5
3	Fen deneylerinin ne işe yaradığını öğrencilere açıklayabilme konusunda kendime güveniyorum	1	2	3	4	5
4	Fen bilimlerini etkili bir şekilde öğretebileceğim konusunda kendime güveniyorum.	1	2	3	4	5
5	Fen öğretiminde etkili olabilmek için fen kavramlarını yeterince iyi biliyorum.	1	2	3	4	5
6	Seçme şansı verilirse, fen öğretimimi değerlendirmesi için bir meslektaşımı dersime davet ederim.	1	2	3	4	5
7	Öğrencilerin fen sorularını yanıtlayabileceğim konusunda kendime güveniyorum.	1	2	3	4	5
8	Öğrenciler bir fen kavramını anlamada zorlanırsa, o kavramı daha iyi anlamalarına nasıl yardım edeceğimi bildiğim konusunda kendime güveniyorum.	1	2	3	4	5
9	Fen öğretirken, öğrenci sorularını hoş karşılayacak kadar kendime güveniyorum.	1	2	3	4	5
10	Öğrencilerin fen bilimlerine olan ilgisini artırmak için ne yapacağımı biliyorum.	1	2	3	4	5

2. **Aşağıda fen öğretiminiz ile ilgili <u>genel olarak</u> ne hissettiğiniz hakkında bazı ifadelere yer verilmiştir. Lütfen bunları sizi yansıtacak şekilde işaretleyiniz.**

		Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1	Bir öğrenci fen bilimlerinde her zamankinden daha başarılı olduğunda, bu durum genellikle öğretmenin daha fazla çaba sarf etmesinden kaynaklanmaktadır.	1	2	3	4	5
2	Bir öğrencinin fen bilimleri altyapısındaki yetersizliği, iyi öğretimle aşılabilir.	1	2	3	4	5
3	Bir öğrencinin fen bilimlerinde öğrendikleri beklenenden daha fazlaysa, bunun nedeni çoğu kez öğretmenlerinin daha etkili bir öğretim yaklaşımı kullanmış olmasıdır.	1	2	3	4	5
4	Öğrencilerin fen konularını öğrenmesinden genellikle öğretmen sorumludur.	1	2	3	4	5
5	Eğer öğrencilerin fen bilimlerinde öğrendikleri beklenenden az ise, bunun nedeni büyük olasılıkla verimsiz fen öğretimidir.	1	2	3	4	5
6	Öğrencilerin fen bilimlerinde öğrendikleri, öğretmenlerinin fen öğretiminin etkili olması ile direkt ilişkilidir.	1	2	3	4	5
7	Düşük başarılı bir öğrenci, fen bilimlerinde beklenenden daha fazla ilerleme kaydettiğinde, bu durum genellikle öğretmenin onunla daha fazla ilgilenmesinden kaynaklanmaktadır.	1	2	3	4	5
8	Eğer ebeveynler çocuklarının okulda fen bilimlerinde daha fazla ilgi gösterdiğini söylüyorsa, bu muhtemelen çocuğun öğretmeninin performansından kaynaklanıyordur.	1	2	3	4	5
9	Öğrencilerin fen bilimlerindeki en ufak öğrenmesinin bile genellikle onların öğretmeninden kaynaklandığı düşünülebilir.	1	2	3	4	5

3. Aşağıda matematik öğretimi ile ilgili bazı ifadelere yer verilmiştir. Bunları kendi öğretiminizi yansıtacak şekilde işaretleyiniz.

		Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1	Matematik öğretimi uygulamalarımı sürekli geliştiriyorum.	1	2	3	4	5
2	Matematiği etkili bir şekilde öğretmek için gerekli adımları biliyorum.	1	2	3	4	5
3	Matematik etkinliklerinin ne işe yaradığını öğrencilere açıklayabilme konusunda kendime güveniyorum.	1	2	3	4	5
4	Matematiği etkili bir şekilde öğretebileceğim konusunda kendime güveniyorum.	1	2	3	4	5
5	Matematik öğretiminde etkili olabilmek için matematik kavramlarını yeterince iyi biliyorum.	1	2	3	4	5
6	Seçme şansı verilirse, matematik öğretimimi değerlendirmesi için bir meslektaşımı dersime davet ederim.	1	2	3	4	5

7	Öğrencilerin matematik sorularını yanıtlayabileceğim konusunda kendime güveniyorum.	1	2	3	4	5
8	Öğrenciler bir matematik kavramını anlamada zorlanırsa, o kavramı daha iyi anlamalarına nasıl yardım edeceğimi bildiğim konusunda kendime güveniyorum.	1	2	3	4	5
9	Matematik öğretirken, öğrenci sorularını hoş karşılayacak kadar kendime güveniyorum.	1	2	3	4	5
10	Öğrencilerin matematiğe olan ilgisini artırmak için ne yapacağımı biliyorum.	1	2	3	4	5

4.Aşağıda matematik öğretiminiz ile ilgili <u>genel olarak</u> ne hissettiğiniz hakkında bazı ifadelere yer verilmiştir. Lütfen bunları sizi yansıtacak şekilde işaretleyiniz.

		Kesinlikle katılmıyorum	**Katılmıyorum**	**Kararsızım**	**Katılıyorum**	**Kesinlikle katılıyorum**
1	Bir öğrenci matematikte her zamankinden daha başarılı olduğunda, bu durum genellikle öğretmenin daha fazla çaba sarf etmesinden kaynaklanmaktadır.	1	2	3	4	5
2	Bir öğrencinin matematik altyapısındaki yetersizliği, iyi öğretimle aşılabilir.	1	2	3	4	5
3	Bir öğrencinin matematikte öğrendikleri beklenenden daha fazlaysa, bunun nedeni çoğu kez öğretmenlerinin daha etkili bir öğretim yaklaşımı kullanmış olmasıdır.	1	2	3	4	5
4	Öğrencilerin matematik konularını öğrenmesinden genellikle öğretmen sorumludur.	1	2	3	4	5
5	Eğer öğrencilerin matematikte öğrendikleri beklenenden az ise, bunun nedeni büyük olasılıkla verimsiz matematik öğretimidir.	1	2	3	4	5
6	Öğrencilerin matematikte öğrendikleri, öğretmenlerinin matematik öğretiminin etkili olması ile direkt ilişkilidir.	1	2	3	4	5
7	Düşük başarılı bir öğrenci, matematikte beklenenden daha fazla ilerleme kaydettiğinde, bu durum genellikle öğretmenin onunla daha fazla ilgilenmesinden kaynaklanmaktadır.	1	2	3	4	5
8	Eğer ebeveynler çocuklarının okulda matematiğe daha fazla ilgi gösterdiğini söylüyorsa, bu muhtemelen çocuğun öğretmeninin performansından kaynaklanıyordur.	1	2	3	4	5
9	Öğrencilerin matematikteki en ufak öğrenmesinin bile genellikle onların öğretmeninden kaynaklandığı düşünülebilir.	1	2	3	4	5

5.Aşağıda ders verdiğiniz ortamda öğrencilerin teknolojiyi ne sıklıkla kullandığıyla ilgili bazı ifadelere yer verilmiştir. Lütfen bunları sizin öğretim ortamınızı yansıtacak şekilde işaretleyiniz. Eğer soru sizin durumunuzla uyumlu değilse, "UYGUN DEĞİL" seçeneğini işaretleyiniz.

		Hiç bir zaman	Nadiren	Bazen	Genellikle	Her zaman	UYGUN DEĞİL
1	Çeşitli teknolojileri kullanırlar (örneğin; veri görselleştirme, araştırma ve iletişim araçları).	1	2	3	4	5	6
2	Sınıf dışında da, başkalarıyla iletişim kurmak ve işbirliği yapmak için teknolojiyi kullanırlar.	1	2	3	4	5	6
3	Etkinliklerin bir parçası olarak, çevrimiçi (online) kaynaklara ve bilgiye erişmek için teknolojiyi kullanırlar.	1	2	3	4	5	6
4	Profesyonel araştırmacıların kullandığı araçlarla (örneğin; simülasyonlar, veri tabanları, uydu görüntüleri) aynı türden araçlar kullanırlar.	1	2	3	4	5	6
5	Teknolojinin gerçek yaşamdaki uygulamalarını konu alan teknoloji destekli projeler üzerinde çalışırlar.	1	2	3	4	5	6
6	Problemleri çözmeye yardımcı olması için teknolojiyi kullanırlar.	1	2	3	4	5	6
7	Üst düzey düşünme becerilerini (örneğin: analiz, sentez ve değerlendirme) desteklemek için teknolojiyi kullanırlar.	1	2	3	4	5	6
8	Yeni fikirler üretmek ve bilgilerin temsillerini oluşturmak için teknolojiyi kullanırlar.	1	2	3	4	5	6

6.Aşağıda bir dizi öğrenci görevlerine yer verilmiştir. Lütfen bunlarla, sizin dersinizde öğrencilerin ne sıklıkla uğraştığını yansıtacak şekilde işaretleyiniz.

		Hiç bir zaman	Nadiren	Bazen	Genellikle	Her zaman
1	Araştırmalar yaparak (örneğin; bilimsel tasarım ya da teorik araştırmalar) problem çözme becerileri geliştirirler.	1	2	3	4	5
2	Küçük gruplarla çalışırlar.	1	2	3	4	5
3	Test edilebilir tahminler yaparlar.	1	2	3	4	5
4	Dikkatli gözlemler ve ölçümler yaparlar.	1	2	3	4	5
5	Veri toplamak için araçlar kullanırlar (örneğin; hesap makinesi, bilgisayar, bilgisayar programları, terazi, cetvel, pusula, vb.)	1	2	3	4	5
6	Verideki örüntüyü fark ederler.	1	2	3	4	5
7	Bir deney veya araştırmanın bulgularına mantıklı açıklamalar getirebilirler.	1	2	3	4	5
8	Sonuçları ifade etmek için en uygun yöntemleri seçerler (örneğin; çizimler, modeller, çizelgeler, grafikler, teknik bir dil, vb.).	1	2	3	4	5
9	Etkinlikleri, gerçek hayat şartlarında uygularlar.	1	2	3	4	5
10	İçerik odaklı karşılıklı konuşmaya katılırlar.	1	2	3	4	5
11	Soyut akıl yürütme yaparlar.	1	2	3	4	5

12	Niceliksel akıl yürütme yaparlar.	1	2	3	4	5
13	Başkalarının yaptığı yorumları eleştirirler.	1	2	3	4	5
14	Dersin içeriğiyle ilgili meslekleri öğrenirler.	1	2	3	4	5

7. Öğrencilerin aşağıda belirtilen durumlarla ilgili <u>öğrenme fırsatlarına sahip olmasını</u> ne derece önemsediğinizi işaretleyiniz.

		Hiç önemsemiyorum	**Önemsemiyorum**	**Kararsızım**	**Önemsiyorum**	**Çok önemsiyorum**
1	Bir hedefe ulaşmak için başkalarına öncülük etmek.	1	2	3	4	5
2	Başkalarını yapabileceklerinin en iyisini yapmaları için cesaretlendirmek.	1	2	3	4	5
3	Yüksek nitelikli iş üretmek.	1	2	3	4	5
4	Akranlarının farklılıklarına saygı duymak.	1	2	3	4	5
5	Akranlarına yardım etmek.	1	2	3	4	5
6	Karar verirken başkalarının bakış açılarını dahil etmek.	1	2	3	4	5
7	İşler planlandığı gibi gitmeyince değişiklikler yapmak.	1	2	3	4	5
8	Kendi öğrenme hedeflerini belirlemek	1	2	3	4	5
9	Kendi başına çalışırken zamanı akıllıca yönetmek.	1	2	3	4	5
10	Birçok görev içinde hangisinin ilk olarak yapılması gerektiğini seçmek.	1	2	3	4	5
11	Farklı altyapıya (sosyal çevre, geçmiş deneyimler, vb.) sahip öğrencilerle iyi çalışmak.	1	2	3	4	5

8.Aşağıda öğretmen liderliği ile ilgili bazı ifadelere yer verilmiştir. Lütfen bunları kendi öğretiminizi yansıtacak şekilde işaretleyiniz.

		Kesinlikle katılmıyorum	**Katılmıyorum**	**Kararsızım**	**Katılıyorum**	**Kesinlikle katılıyorum**
1	Öğretmenlerin, bütün öğrencilerin öğrenmesinin sorumluluğunu alması önemlidir.	1	2	3	4	5
2	Öğretmenlerin, öğrenciler ile vizyon paylaşımının önemli olduğunu düşünüyorum.	1	2	3	4	5

3	Öğretmenlerin, öğrencilerin gelişim sürecini değerlendirmek için~~,~~ yıl boyunca çeşitli ölçme verilerini kullanmasının önemli olduğunu düşünüyorum.	1	2	3	4	5
4	Öğretmenlerin, öğretimlerini düzenlemek, planlamak ve hedefler koymak için çeşitli veriler kullanmasının önemli olduğunu düşünüyorum.	1	2	3	4	5
5	Öğretmenlerin, güvenli ve düzenli bir ortam oluşturmasının önemli olduğunu düşünüyorum.	1	2	3	4	5
6	Öğretmenlerin, öğrencilere yetki vermesinin önemli olduğunu düşünüyorum.	1	2	3	4	5

9.Aşağıda FeTeMM (Fen, Teknoloji, Mühendislik ve Matematik) meslekleri ile ilgili bazı ifadelere yer verilmiştir. Lütfen bunlara ne derece katılıp katılmadığınızı belirtiniz.

		Kesinlikle katılmıyorum	Katılmıyorum	Kararsızım	Katılıyorum	Kesinlikle katılıyorum
1	Güncel FeTeMM mesleklerini biliyorum.	1	2	3	4	5
2	FeTeMM meslekleri hakkında daha fazla bilgi edinmek için nereye gitmem gerektiğini biliyorum.	1	2	3	4	5
3	Öğrencilere FeTeMM mesleklerini öğretmek için nerelerden kaynak bulacağımı biliyorum.	1	2	3	4	5
4	Öğrencileri veya ebeveynleri FeTeMM meslekleri hakkında bilgi edinmeleri için nereye yönlendireceğimi biliyorum.	1	2	3	4	5

B
Interview Protocol

1. Sizce STEM nedir?
2. Yeni eğitim öğretim programında yer alması söz konusu olmadan önce STEM hakkında bir bilginiz var mıydı? Bu bilgiyi nerden edindiniz?

3.1. STEM eğitimi aldıysanız, STEM temelli etkinlikleri uygulama konusunda bu eğitimin size yararı oldu mu? Eğitim öğretim programında yer almadan önce STEM'i derslerinize entegre ediyor muydunuz? Nasıl?

3.2. Herhangi bir STEM eğitimi almadıysanız, STEM temelli etkinlikleri uygulama konusunda nasıl bir yol izlemeyi düşünüyorsunuz?

4. STEM'e öncelikle fen ve mühendislik uygulamaları ünitesi adı altında yeni öğretim programında yer verildi. Ancak sonrasında STEM ayrı bir ünite olarak değil tüm ünitelerin içine entegre olacak şekilde yeni öğretim programına yerleştirildi. Bu değişiklik hakkında ne düşünüyorsunuz? Sizce bu değişiklikler uygulanabilir mi? Hangi şekilde daha verimli bir eğitim süreci sağlanabilir?

   (STEM temelli etkinliklerin hangi fen konularına daha uygun olduğunu düşünüyorsunuz?)

5. Öğretmen bakış açısıyla değerlendirdiğinizde STEM entegrasyonunun fen eğitim öğretimini nasıl etkileyeceğini düşünüyorsunuz? Öğrencilerin başarıları üzerine nasıl etkisi olur?

   (Eğitim öğretim sürecinin parçası olan öğretmen, veli, öğrenci ve okul yönetimi taraflarına bu yeni yaklaşımın olumlu/olumsuz ne gibi etkileri olacaktır? Yaşanacak zorluklar ve sağlanacak faydalar sizce nelerdir?)

   (Öğretmen/öğrenci/veli/okul yönetimi açısından fen derslerinde STEM temelli etkinliklerin kullanımının avantajları/dezavantajları nelerdir?)

6. Fen derslerinde STEM temelli etkinlikleri kullanacak öğretmenlere önerileriniz nelerdir?

C

Permission E-Mail For Data Collection Tool

Yasemin Tas <yasemintas@atauni.edu.tr>
Alıcı: ben

Merhaba Rukiye Hanim,

Ekte T-STEM'in Turkce'ye uyarlama calismamizda haziladigimiz manual'i gorebilirsiniz.

Bu manual'da, olcek maddelerini, dogrulayici faktor analizi sonuclarini, alt boyutlara ait guvenirlik katsayilarini ve alt boyutlar arasindaki iliskileri gorebilirsiniz.

Calismalarinizda kolayliklar dilerim
Dr. Yasemin Tas

Kimden: "Rukiye Bektas" <rukiye.bektas14@gmail.com>
Kime: yasemintas@atauni.edu.tr
Gönderilenler: 18 Nisan Salı 2017 13:45:33
Konu: T-STEM türkçe versiyonu

...

Rukiye Bektas <rukiye.bektas14@gmail.com>
Alıcı: Yasemin

Yasemin Hocam
Çalışmanızı benimle paylaştığınız için çok teşekkür ederim. Anketinizi kullanmak için bana izin verdiğinizi belirten resmi bir yazı yazmanız mümkün mü acaba?
Tekrar teşekkür ederim.
Rukiye Bektaş

18 Nis 2017 14:06 tarihinde "Yasemin Tas" <yasemintas@atauni.edu.tr> yazdı:

...

Yasemin Tas <yasemintas@atauni.edu.tr>
Alıcı: ben

Sayın Rukiye Bektaş,

Friday Institute for Educational Innovation (2012) tarafından geliştirilen Teacher Efficacy and Attitudes Toward STEM (T-STEM) Survey'in, tarafımızca yapılan Türkçe uyarlamasını araştırmanızda kullanabileceğinizi belirtirim.

Yrd. Doç. Dr. Yasemin Taş

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Publications from the thesis

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Conference Papers

1. Paper 1: Bektaş, R. and Coştu, B. (2018, February). *STEM Education: Attitudes and Readiness of In-service Science Teachers.* Paper presented at the XV. European Conference on Social and Behavioral Sciences, Kuşadası.