EXPLORING OF STEM READINESS OF A FACULTY OF EDUCATION IN TURKEY

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I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

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ABSTRACT

EXPLORING OF STEM READINESS OF A FACULTY OF EDUCATION IN TURKEY

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In the 21st century, it is important that individuals have features of creativity, strong communication skills, critical and analytical thinking, and ability to collaborate. Providing an interdisciplinary learning in all processes from pre-school to higher education is an important advantage for countries bringing these properties to its citizens and becoming one leading countries of the world in the future. That interdisciplinary learning is possible by integrating the knowledge of science, technology, engineering, and mathematics [STEM] together. On September 6, 2016, the Ministry of National Education [MoNE] published the STEM education report and plans to revise the education system to include STEM education. In this context, it is also very important whether the Faculty of Education has sufficient qualification to provide this education. If we consider that the success of the students is also the effect of the skills of teachers; it is also important for educational faculties to be able to train teachers in this context in an effective STEM education. The aim of this study is to explore the readiness level of a faculty of education in Turkey for providing effective STEM education in terms of the STEM Framework prepared by New York City Department of Education [NYCDOE] (2015) by considering the ideas of elements of this faculty.

Keywords: STEM Education, STEM Readiness, Faculty of Education

ÖZ

TÜRKİYE'DE BİR EĞİTİM FAKÜLTESİNİN STEM EĞİTİMİNE HAZIR OLMA DURUMLARININ KEŞFİ

Kılınç, Selçuk
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21. yüzyılda, bireylerin yaratıcılık, güçlü iletişim becerileri, eleştirel ve analitik düşünme ve iş birliği yapma özelliklerine sahip olmaları önemlidir. Okul öncesi eğitimden yüksek öğretime kadar tüm süreçlerde disiplinler arası bir öğrenme sağlamak, bu özellikleri vatandaşlarına kazandıran ve gelecekte dünyanın önde gelen ülkelerinden biri olan ülkeler için önemli bir avantajdır. Disiplinler arası öğrenme, Fen Bilimleri, Teknoloji, Mühendislik ve Matematiğin [FeTeMM] bilgilerini bir araya getirerek mümkündür. 6 Eylül 2016 tarihinde Millî Eğitim Bakanlığı tarafından STEM eğitimi raporu yayınlanmıştır ve eğitim sistemimizin STEM eğitimini de içine alacak şekilde revize edilmesi planlanmaktadır. Bu kapsamda Eğitim Fakültelerinin bu eğitimi yeterli düzeyde verebilecek öğretmen yetiştirme yeterliliğine sahip olup olmadığı da büyük önem taşımaktadır. Çünkü öğrencilerin başarısı üzerinde öğretmenlerin becerilerinin de etkisi olduğunu göz önünde bulundurursak; etkili bir STEM eğitiminde eğitim fakültelerinin bu kapsama uygun öğretmen yetiştirebilmeleri de bir hayli önemlidir. Bu çalışmanın amacı, Türkiye'de bir eğitim fakültesinin New York Şehri Eğitim Departmanı (2015) tarafından hazırlanan STEM Çerçevesi baz alınarak etkili bir STEM eğitimi sağlamak için hazır olma düzeyini bu fakültenin unsurlarının fikirlerini dikkate alarak keşfetmektir.

Anahtar Kelimeler: STEM Eğitimi, STEM Hazırbulunuşluğu, Eğitim Fakültesi

To my beloved family and the memory of Fatma Kılınç

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TABLE OF CONTENTS

APPENDICES

LIST OF TABLES

TABLES

LIST OF FIGURES

FIGURES

LIST OF ABBREVIATIONS

BILTEMM	Bilim, Teknoloji, Mühendislik ve Matematik Eğitimi Uygulama ve Araştırma Merkezi
B.S.	Bachelor of Science
CCM	Constant Comparative Method
CEIT	Computer Education and Instructional Technology
DTI	Danish Technological Institute
EBA	Eğitim Bilişim Ağı
ESM	Education Service Centers
ITEA	International Technology Education Association
MEB	Milli Eğitim Bakanlığı
MEM	Milli Eğitim Müdürlüğü
MoNE	Ministry of National Education
M.Sc.	Master of Science
NAE	National Academy of Engineering
NEGP	National Educational Goals Panel
NGO	Non-governmental Organizations
NGSS	Next Generation Science Standards
NRC	National Research Council
NSF	National Science Foundations
NYCDOE	The New York City Department of Education
P21	Partnership for 21st Century Learning
PCAST	The President's Council of Advisors on Science and Technology
PISA	The Programme for International Student Assessment
OECD	Organization for Economic Co-operation and Development
STEM	Science, Technology, Education, and Mathematics
TÜBİTAK	Türkiye Bilimsel ve Teknolojik Araştırma Kurumu
TÜSİAD	Türkiye Sanayici ve İşadamları Derneği

US	The United States (America)
USA	The United States of America

CHAPTER 1

INTRODUCTION

We are in the process of science and technology in the 21^{st} century. This change in science and technology impose the obligation of having different skills for our modern people. These skills are called 21^{st} Century skills and Partnership for 21^{st} Century Learning [P21] described those as critical thinking and problem solving, creativity and innovation, information literacy, media literacy, technology literacy, communication, and collaboration (Partnership for 21^{st} Century Learning, 2015). It is necessary to use appropriate paradigms and learning models of the 21^{st} century to be able to acquire skills.

Today's leading countries in the world owe their leadership to basic science, technology, engineering and therefore a production-based economy. In the 21^{st} Century, it is important that individuals have features of creativity, strong communication skills, critical and analytical thinking, and ability to collaborate. Providing an interdisciplinary learning in all processes from pre-school to higher education is an important advantage for countries bringing these properties to its citizens and becoming one the world's leading countries in the future.

That interdisciplinary learning is possible by integrating the knowledge of STEM together. STEM evolved out of government policy, specifically from within the National Science Foundation [NSF], according to a review of literature over the past 10 years. Before deciding on the STEM, NSF first used SMET acronym for science, mathematics, engineering, and technology in the early 1990s. Then, they changed it to STEM because SMET acronym could cause vulgarity issues (Sanders, 2009).

The first person who used STEM acronym for the aim of referring science, technology, engineering, and mathematics curriculum in 2001 is Judith A. Ramaley who is the former director of the NSF's Education and Human-Resources Division (Teaching Institute for Excellence in STEM, 2010). STEM fields are classified by NSF broadly, including not only the common categories of engineering, natural sciences, computer and information sciences, and mathematics, but also behavioral/social sciences like economics, political science, sociology, psychology (Green, 2007).

STEM education, that has become a state policy in recent years, especially in the United States [USA] with a higher share of the budget, is one of these paradigms (Akgündüz, Ertepınar, 2015). STEM education which is one of the most important paradigms in the world in the 21st century has great importance in terms of transforming theoretical knowledge into product acquisition of skills. You can integrate basic sciences such as mathematics and science with the engineering and technology applications thanks to STEM education.

The general purpose of STEM Education is the progression of economy and education of creative leaders who have caught up to the age of knowledge and information. One of the important aims of the STEM education is to create a leading country that will guide the global economy by educating scientists, engineers, medical scientists, mathematicians. The fact that more qualified workers will be needed in the future is another reason for giving importance to STEM fields. (Danish Technological Institute [DTI], 2015; The President's Council of Advisors on Science and Technology [PCAST], 2012). In addition, there is more vacancy and more need in STEM fields compared to non-STEM fields (PCAST, 2010).

Integration of STEM education into national education system will be allowed to us grow up creative, productive, and equipped with 21st century skills generations. The destiny of any nation depends on the education system because the education system shapes citizens during compulsory education, possibly with the inclusion of higher education. For this reason, the most important task of the system besides the success in social sciences or in the arts is to have qualified internal power and a strong industry by educating students in STEM fields (DTI, 2015; National Economic Council, Council of Economic Advisers, & Office of Science, and Technology Policy, 2011; PCAST, 2010).

Also, the only thing that matters here is not the number of students who prefer STEM fields in university education. In addition, the number of students who prefer to work in STEM fields after graduation is also important. (PCAST, 2012). Because some students have graduated from STEM fields, but they do not work in these areas. (Chen, 2014) The conclusion we receive from this information is that what STEM training should focus on must be such as to increase the STEM workforce in the future. However, STEM education is not only for the student who will work at STEM fields but also for all students.

1.1 STEM Education

There are different point of views about STEM education. Some people think it can only taught be while integrating curricula of four components, which are science, technology, engineering, and math, to being closely parallel the work of an engineer or a real-life scientist. According to others, STEM is the push for graduating more students in the science, technology, engineering, and mathematics fields for the aim of maintaining its competitiveness of the country not to fall behind emerging countries (Breiner, Johnson, Harkness, & Koehler, 2012). STEM is the purposeful integration of the various disciplines as used in solving real world problems (Labov, Reid, & Yamamoto, 2010; Sanders, 2009).

STEM education can be referred to as a teaching system that aims at the integration of four important disciplines such as science, technology, engineering, and mathematics, including interdisciplinary and applied approaches. STEM education focuses on science and mathematics disciplines, as well as technology and engineering (Bybee, 2010). This STEM education perspective teaches the integrated disciplines as one cohesive entity. Because it includes viewing the separate disciplines such as science, technology, engineering, and mathematics as one unit.

STEM education may vary because of differences in the integration of technology and engineering domains. Bybee (2013) clarified and summarized these nine different STEM education perspectives based on the many articles, projects, discussion, and reports related to STEM. These nine different definitions are listed below.

- *STEM equals Science (or Mathematics:* refers to only one discipline and confusing because of contrast of multiple discipline orientations compared to the single discipline reference.

- *STEM Means Both Science and Mathematics:* refers to only these two disciplines and usually due to these components using as curricular components

- *STEM Means Science and Incorporates Technology, Engineering, or Math:* refers to integration of the one of the three components, engineering, mathematics, or technology, to science course which is accepted as integral part of the education

- *STEM Equals a Quartet of Separate Disciplines:* refers to covering all four components in one course or four different courses and may cause problems at the point of involvement of engineering and technology

- *STEM Means Science and Math Are Connected by One Technology or Engineering Program*: refers to involvement of either engineering or technology applications in mathematics and science classes with the assumption of math/science courses being integral part of the curriculum

- *STEM Means Coordination Across Disciplines:* refers to connecting of these disciplines as pairs among them

- *STEM Means Combining Two or Three Disciplines:* refers to integration of these disciplines as double or triple with the same implication

- *STEM Means Complementary Overlapping Across Disciplines:* refers to teaching these disciplines one at a time but not together at a one course

- *STEM Means a Transdisciplinary Course or Program:* refers to producing possible solutions to major issues by using the knowledge of all four discipline together

As it can be seen from these definitions, the place where STEM differs from classical education given up to now is to what degree and how integrated the technology and engineering dimension is the education. Mathematics and science are already elements of education, so there is a lot of information about how to do their teaching, but there are some outstanding issues about how to include technology and engineering in education. The probable reasons for the problems experienced here are that the roots of these two components' education are not as old as math and science education (National Academy of Engineering [NAE], 2009).

Technology is another thing that creates confusion and does not attach importance. According to the International Technology Education Association [ITEA] (2007), “technology is how people modify the natural world to suit their own purposes.” (p.2). When we think based on this definition, we can see that the concept of technology is very wide. Because everything that makes our life easier is a kind of technology. However, technology is something that renews itself over time. For example, in olden times, a pencil could be seen as a technology, but nowadays it can be somewhat absurd to classify it as technology (Simon, 1969).

Educators see the use of technology and technology integration as a computer or smartboard integration into their current lessons. But the aim of STEM education is to transform the students into technologically literate individuals. A technologically literate person needs to understand what technology is, how it is created, how s/he shapes the society, and how s/he is shaped by society (ITEA, 2007). From this point of view, watching videos, playing educational games, or introducing simulations in a lesson on computer or smartboard may increase the computer knowledge of the student, but doubts about contributing to its level of technologically literacy. For this reason, educators must demonstrate that technology component of STEM is well-assimilated and that it is necessary to distinguish it from computer use in its lessons in order to achieve student success.

Engineering, which many educators regard as the least important component of STEM despite being the basis of STEM education in fact, is the other thing to be discussed (Basham, Marino, 2013). It was stated that the least used and least understood letter E in the four letters in the STEM shortening (Katehi, Pearson, & Feder, 2009). However, K-12 education should focus on engineering design besides other important features according to them. Engineering design is concerned with developing solutions by taking into account what the engineers call constraints and although this process is not always necessary, it involves a concrete product. The design and construction of this product make it possible for students to learn more deeply about concepts.

Although the engineering design process includes steps such as identifying the problem, doing the necessary research, obtaining, and designing the product, testing the designed product, and reviewing the solution according to results, these steps may not be followed in K-12 education like higher education. For this reason, the engineering education given in K-12 education encourages students' future career preferences and gives them the ability to think creatively by encouraging them to think like an engineer. In addition, a much more meaningful and profound learning process has been realized since students will learn by doing. As a result of these trainings, students can be engineers (Honey, Pearson & Schweingruber, 2014).

As a result, when we look at the four components of STEM, science and mathematics seem to be essential because they are now considered as front-ends, but we cannot say the same thing for the remaining two dimensions which are technology and engineering. The main difference between the types of education that STEM education comes up to day-to-day is that these two components consist of. For this reason, good engineering and technology training is of utmost importance for good STEM education.

1.2 STEM Education at Different Countries

STEM education is seen as US-based or in this field, the most important country is known as United States, but examining STEM education in different topics in Europe and in our country, will be better in terms of understanding the difference and integrity.

1.2.1 STEM Education in the USA

26% of population of United States belongs to American Indians/Alaska Natives, Hispanics and, African-Americans but their workforce in engineering and science fields is very low. Also, the number of people having STEM degree is more than the number of people working in STEM fields (National Science Board, 2012). Besides minorities, there is also inequality between genders in STEM fields. While a greater portion of females prefer to work in teaching and nursery, only a small part of them working in engineering fields (USA Bureau of Labor Statistics, 2015). Furthermore, according to Figure 1, the expected growth in all STEM business areas between 2010 and 2020 is expected to be 14%. Because of these problems, United States [US] government decided to make some changes at the education system with the aim of solving them and STEM has become a state education policy in the USA.

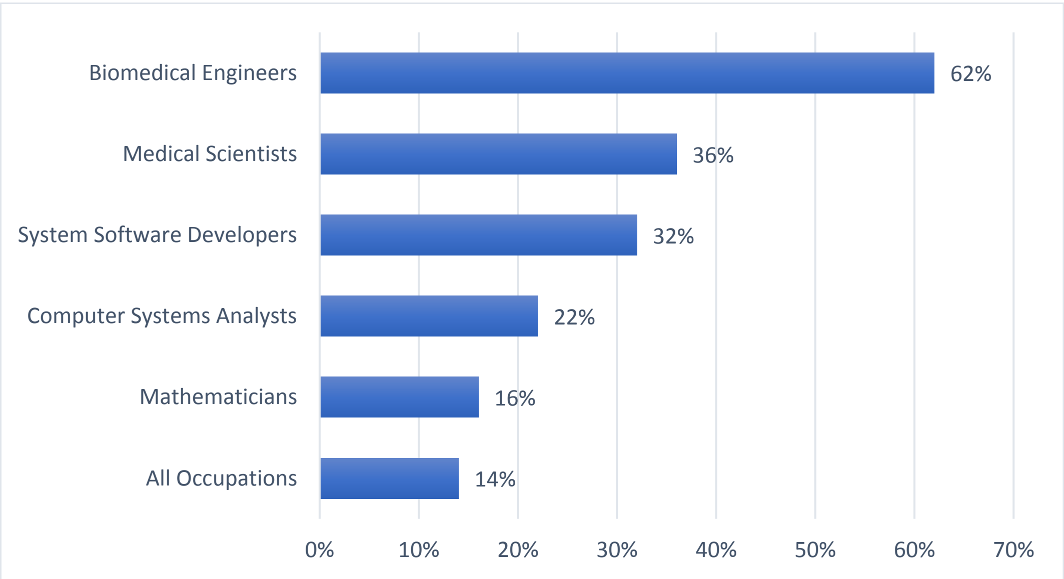

Figure 1. Expected Growth in STEM Business Areas between 2010 and 2020. Adapted from Science, technology, engineering, and math: Education for global leadership, by U.S. Department of Education, 2015, retrieved from http://www.ed.gov/stem. Copyright 2015 by U.S. Department of Education

Former President Barack Obama (2010) said that, "... the leadership of the future depends on how we train our students, especially in the fields of science, technology, engineering, and mathematics." His government allocates funds for education to teachers and students in these areas, and science organizations, science museums and centers and non-governmental organizations [NGO] support this budget. The resources of the US governments have allocated over the past years on the budget are billions of dollars. The budget allocated to equip students with STEM skills is a total of nine billion dollars, which is an average of three billion dollars in 2014, 2015 and 2016 (White House, 2015).

In the United States, STEM specialized schools and the STEM school systems they are part of has very special attention. These schools are particularly prominent schools and some innovative pedagogies like engineering design process and project-based learning are applied to them. With these pedagogies, there will be some expectations from students like having a career in STEM fields and having a strong motivation to develop critical thinking skills. There is not needed any specific exam result or criteria for being accepted to those schools. These county-wide schools have been established not only for successful students but also to encourage students from the lower socioeconomic classes to move to STEM fields. Some lessons applied those schools are robotics, neurobiology, microelectronics, DNA science, advanced physics laboratory, bionanotechnology, and advanced astronomy courses (Akgündüz et al., 2015).

If we take an example of STEM schools in Texas, they are supported by a system consisting of Education Service Centers [ESM], STEM centers established at universities, and STEM coaches. The consequence here is that school success, school attendance, and the responsibility for choosing a university or career choice of students will be distributed to all elements of the system rather than administrators and teachers of STEM schools (Oner et al., 2014).

ESM obligations include identifying the needs of STEM schools and taking measures to meet those needs. The most important obligation of ESMs is meeting the in-service training needs of teachers working in STEM schools. However, when looking at ESM effects on student success, no significant positive impact was found (Öner et al., 2014; Erdoğan, 2014; Philips, 2013). This indicates that the in-service trainers in the ESMs are not sufficiently trained in pedagogy or content knowledge and cannot successfully reconcile these two types of knowledge.

1.2.2 STEM Education in EU

STEM education is not only important for United States, but also to Europe's agenda. Concern about the fall in the number of young people's interest in STEM fields is also similar in Europe. In 2007, the European Union published the report "Science Education NOW: A renewed pedagogy for the future of Europe, Brussels: European Commission" (Rocard et al., 2007), with striking results.

It is said that young people in Europe's interest in mathematics, science and technology has declined dramatically, and that technology and science education have gone badly. It was emphasized that this would significantly reduce the long-term innovative capacity of Europe if an effective action plan was not prepared for this situation.

The main results and suggestions in the report are as follows:

- Teachers play a key role in renewing science education. Teachers who will increase the quality of their own teaching with possible teacher networks to be created will increase their motivation in this way.
- As a pedagogy adopted in science teaching, using a method which is based on inquiry rather than classical methods will significantly increase the interest of students to the science.
- Inquiry-based science education and renewed school science teaching will lead to opportunities for collaboration among stakeholders in formal and informal areas.

After the report and the findings obtained, the European Union made some project calls with the aim of renewing science education based on inquiry teaching and renewing European science and technology education. While several projects such as Ark of Inquiry, Mascil, S-Team, Sails, and Profiles were supported between 2007 and

2013 under the 7th framework program, then Horizon 2020 program was started between 2014 and 2020 after 7th framework program (Horizon 2020, 2015).

1.2.3 STEM Education in Turkey

Regardless of STEM education, the enrollment rate and the number of students enrolled in schools are important in terms of development level and development potential of a country. The competitiveness of countries is measured by taking into account the capacity of science, technology, innovation and human raising in this process which emerged in the last quarter of the 21st century and is called 'knowledge economy' and 'knowledge society'. In this process, the importance given to higher education/universities within the scope of their aims and the expectations from it has been increasingly deepened (Günay & Günay, 2016).

The raw data considered to be a basis for decisions taken or considered to be taken under the education policy are seen as supportive tools in this context but, in education analyzes, raw data such as the number of students enrolled in education analyzes, only quantitative raw data such as the number of students enrolled in educational institutions may not be sufficient to make the necessary deductions (Mehta, 2004). In view of this situation, not only the schooling rate but also different indicators such as entrance rate and graduation rate have started to be used recently in order to show the expansion in higher education. Many countries have begun to focus on the schooling rate rather than the students, academic staff, number of universities, or research activities to show expansion (Teichler, 2004). Organization for Economic Co-operation and Development [OECD] also uses countries' schooling rates as an indicator of international comparability and human capital measurement (Hansson, 2008).

If we look at the 2016 data; we see that Turkey has 79.79% schooling ratio of secondary school, 94.39% schooling ratio of junior high school, and 94.87% schooling ratio of primary school (Türkiye İstatistik Kurumu, n.d.). In addition to these statistics; if we look at the level of education in Turkey and compare it with other OECD countries, we see dramatic results. Conclusions about the education level of individual in the 25-64 age range as you can see in Figure 2, raises grave consequences for Turkey when compared with other OECD countries.

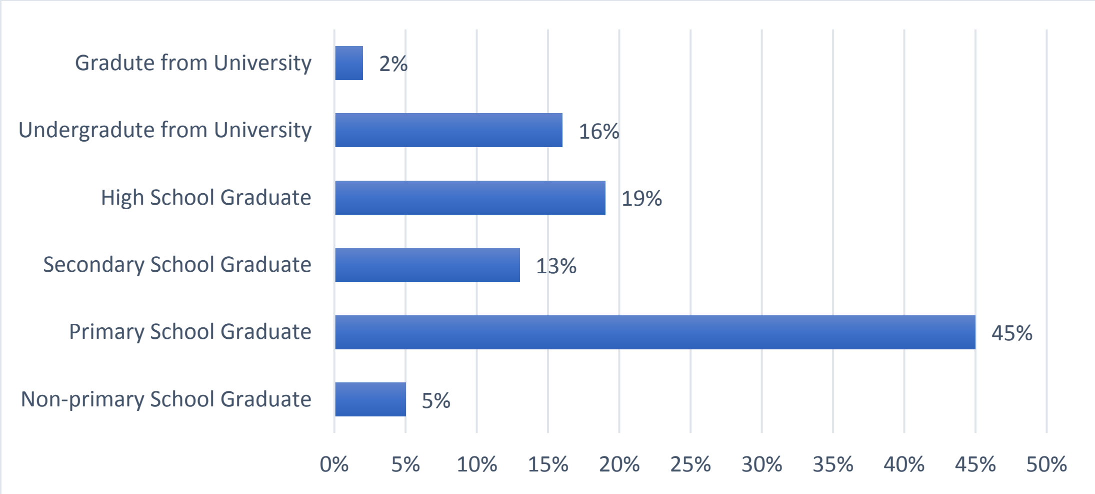

Figure 2. Distribution of Individual in the 25-64 age range Education Level in Turkey at 2015. Adapted from 2016 Eğitim Değerlendirme Raporu, by TEDMEM, 2016, Ankara: Türk Eğitim Derneği Yayınları, retrieved from http://tedmem.org/yayin/2016-egitim-degerlendirme-raporu. Copyright 2016 by TEDMEM.

While non-primary school graduate individual average among OECD countries is 5%, this ratio in Turkey seen as 2%. In addition, the average ratio of individuals whose education level is at primary school and then have not continued their education at OECD is 7% but in Turkey it is 45%. Finally, the OECD average of university and postgraduate education is 35%, this ratio is only 18% in Turkey (TEDMEM, 2016).

When we compared the OECD average of 'Expected Individual Percentage of Education Completion by Levels of Education' with Turkey's statistics, the results are lower again as you can see from Figure 3.

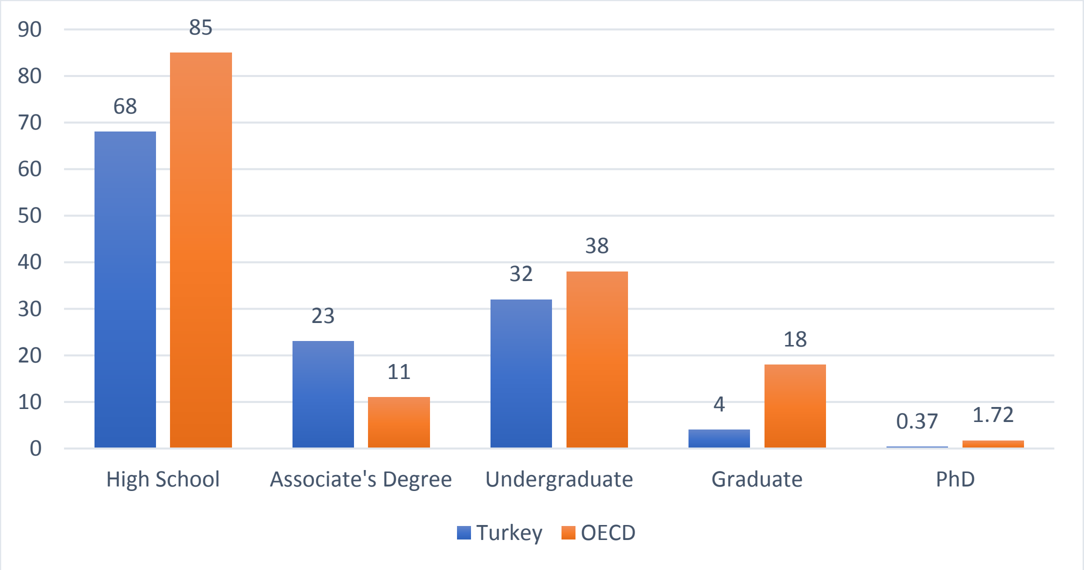

Figure 3. Expected Individual Percentage of Education Completion by Levels of Education. Adapted from 2016 Eğitim Değerlendirme Raporu, by TEDMEM, 2016, Ankara: Türk Eğitim Derneği Yayınları, retrieved from http://tedmem.org/yayin/2016-egitim-degerlendirme-raporu. Copyright 2016 by TEDMEM.

Turkey, while only above the OECD average in associate's degree education completion expected rate of individual branches, lags behind the OECD average in all other stages. In particular, it is well behind the OECD area on the rate of individuals expected to complete graduate and doctoral degrees. When we look at these statistics, we can see most Turkish students drop out education before university level and this indicates that many potential STEM students, graduates, and employees have emerged from this cycle without entering the STEM business area.

In addition to that, most of the high school students who continue their education life do not prefer STEM fields for their career preferences. As you can see in Figure 4; while placement rate of STEM areas of the first 1000 students who settled in at university exam is 85,63 at 2000, this rate has decreased to 27.88% in 2010 and remained at 38.23 in 2014.

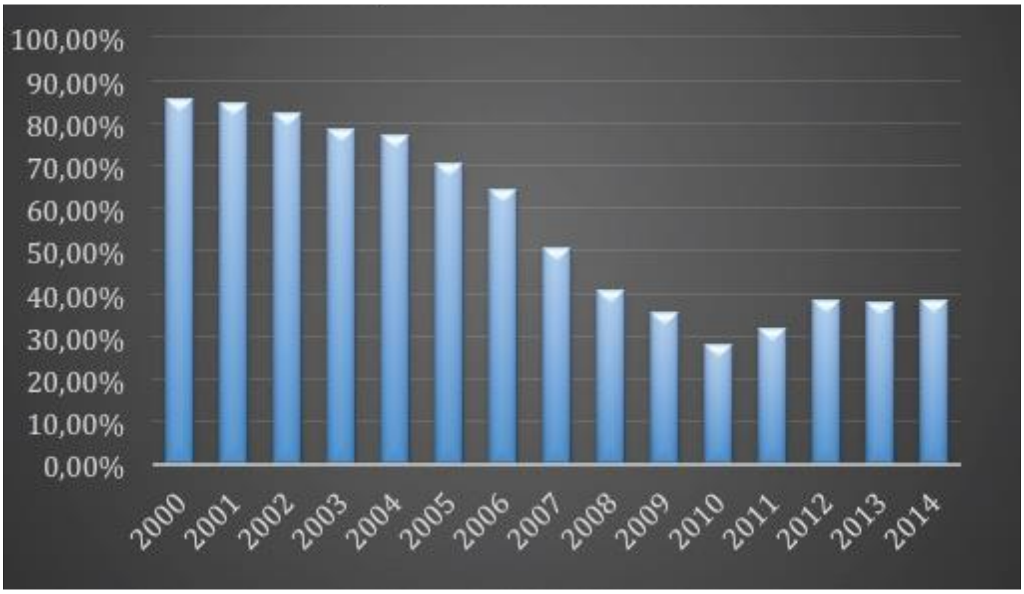

Figure 4. Placement Rate of STEM Areas of the First 1000 Students Who Settled in at University Exam between 2000 and 2014. Adapted from STEM eğitimi Türkiye raporu: Günün modası mı yoksa gereksinim mi?, by Akgündüz, D., Aydeniz, M., Çakmakçı, G., Çavaş, B., Özdemir, S., Çorlu, M. S., & Öner, T., Özdemir S., 2015, İstanbul, Turkey: Aydın Üniversitesi. Copyright 2015 by İstanbul Aydın Üniversitesi

As can be seen from the results, it is clear that the necessity of promoting the STEM career and measures in this regard should be taken. In addition, the findings obtained from statistics show that significant number of students in the first 1000 who do not prefer STEM areas prefer the Faculty of Medicine.

Then, Figure 5 shows the STEM placement rates of the first 1000 male and female students who settled into university at university exam between 2000 and 2014. As you can see from the graph, while the average ratio of male students is 81,39%, this ratio is only 18,61% for female students. When these results are examined it is clear that there is a need for different mechanisms to encourage female students to pursue careers in STEM fields (Sting, 2014).

Blue Line: Male Students - Red Line: Female Students

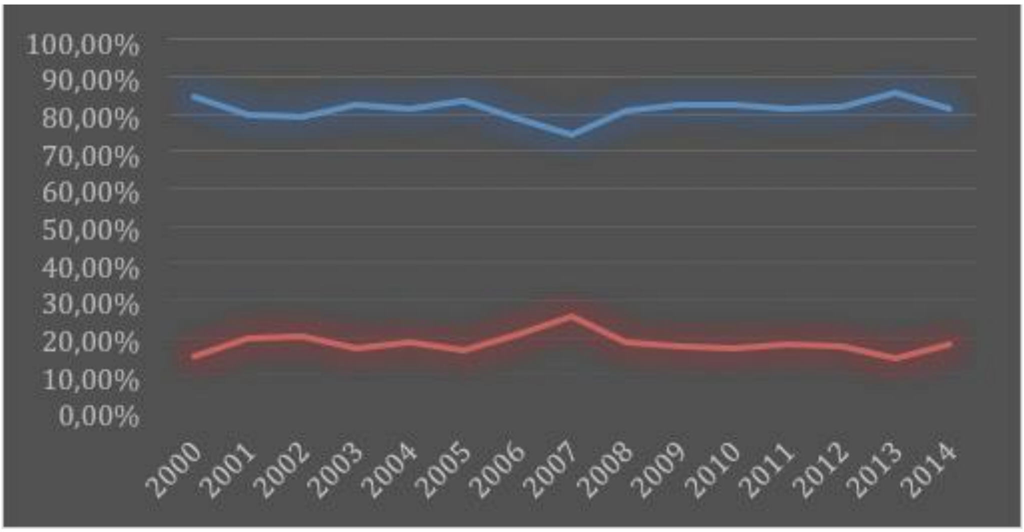

Figure 5. Placement Rates of STEM Areas of the First 1000 Male and Female Students Who Settled in at University Exam between 2010 and 2014. Adapted from STEM eğitimi Türkiye raporu: Günün modası mı yoksa gereksinim mi?, by Akgündüz, D., Aydeniz, M., Çakmakçı, G., Çavaş, B., Özdemir, S., Çorlu, M. S., & Öner, T., Özdemir S., 2015, İstanbul, Turkey: Aydın Üniversitesi. Copyright 2015 by İstanbul Aydın Üniversitesi

Besides the OSYM statistics, when looking at 2015 The Programme for International Student Assessment [PISA] results as you can see in Table 1, Turkey remains below the OECD average in all branches.

Table 1 PISA Results at 2015

Subject	Turkey	OECD Average
Science	425	493
Mathematics	428	493
Reading	420	490

Note. Adapted from PISA 2015 results in focus, by OECD. Copyright 2016 by OECD.

The PISA results that reflect the quality and equity of education in the country, by considering the PISA results we can say that education in Turkey far behind from Finland Singapore which is the head of PISA results. Beside achievement, also the attitude of students toward mathematics and science is also low. Turkey remains well below the OECD average at PISA results like student interest to STEM areas and this situation necessitates an education reform in the country.

These numbers and statistics would have drawn the attention of the MoNE, in the STEM report published in 2016 emphasized that, like other countries, we should focus on STEM education. In the same paper, it is emphasized that teachers should give up the classical teaching methods and instead, choose inquiry-based approaches for bringing cognitive skills and STEM knowledge to students. Furthermore, Eğitim Bilişim Ağı [EBA] and Fatih Project have been put into the forefront and emphasized that the use of technology in education is encouraged and it is said that they can be evaluated as STEM material and thus can meet the requirements for an inquiry-based education (Milli Eğitim Bakanlığı [MEB], 2016).

After several different statistics about the state of education in Turkey, if we look at the things which are related to STEM education we can say that it is particularly important initiatives in recent years. Turkey STEM Education Report (Akgündüz et al., 2015) published by İstanbul Aydın University in 2015 and Turkey’s STEM Workforce Report (Türkiye Sanayici ve İşadamları Derneği [TÜSİAD], 2014) published by TÜSİAD in 2014 can be considered as examples to those initiatives. While STEM Education Report on Turkey emphasizes integration and application of well-founded STEM education to K-12 curriculum; STEM Workforce Report highlights increasing qualified STEM workforce and strengthening STEM areas.

In recent years there has been an increasing trend in the number of projects about STEM. In addition to the project carried out by the Kayseri Milli Eğitim Müdürlüğü [MEM] (Kayseri MEM 2015), the "STEM for Disadvantaged Students Especially Girls" project of Istanbul Aydın University can be evaluated in this context (STEM School, 2015). Apart from these specific examples, we can also see an obvious increase in the number of projects under STEM supported by Türkiye Bilimsel ve Teknolojik Araştırma Kurumu [TÜBİTAK] (TÜBİTAK, 2015). The convergences of the projects are not being integrated and the study of post-school or non-school activities. In addition to these projects, STEM centers were established at universities including Hacettepe University, Middle East Technical University and Bahçeşehir

University. In these centers, it is aimed to improve STEM knowledge by organizing activities, conferences or seminars for students and teachers.

1.3 Statement of the Problem

On September 6, 2016, MoNE published the STEM education report and plans to revise the education system to include STEM education. However, while this change is planned, no study has been conducted on how ready the education faculties are to provide this education to their students. The success of the students is also the effect of the skills of teachers (Rowan, Chiang, Miller, 1997). In addition, apart from all other factors that affect the success of the students, the most important factor in their motivation and success is the quality of the teacher (Tytler & Osborn, 2012).

In this context, it is also very important whether the Faculty of Education has sufficient qualification to provide effective STEM education. A revision made by ignoring the readiness level of the education faculty will not be fruitful, since it will not have a concrete effect. Students or pre-service teachers at these faculties, who will be teachers of tomorrow, will be able to provide effective STEM education to their school when they graduate, only if the faculty provide competent education to them.

The United States, which STEM can show heartily, is aware of this and many professional development programs are underway to bring teachers up to a sufficient level in STEM education (Ashgar, Ellington, Rice, Johnson & Prime, 2012). Likewise, some studies are carried out in Turkey also by the efforts of MoNE, universities or STEM centers.

However, before incorporating STEM education into a curriculum and encouraging teachers to apply STEM education in their classes, Education Faculties' STEM readiness in the current situation should be investigated. The reason for implementing an effective STEM training is primarily to train teachers who can apply an effective STEM education. In order to integrate STEM into the current education system effectively and efficiently, teachers should be well-educated in this field. The greatest responsibility belongs to the current education faculties about this issue.

Although education faculties play such a key role in the current curriculum and education system change, there is no study done about the readiness of them.

1.4 Purpose of the Study

The purpose of the study is to explore the readiness level of a faculty of education in Turkey for providing effective STEM education in terms of the STEM Framework prepared by New York City Department of Education [NYCDOE] (2015) by considering the ideas of elements of this faculty.

1.5 Significance of the Study

There are many studies done and planned related to topics such as STEM education, the importance of STEM education, the contribution of an effective STEM education to the country and the students, and the possible revisions to the education system based on the STEM education. However, while STEM education has become so popular and everyone has begun to talk about their benefits, integrate it into their lessons; the situation of faculties of education is not given importance.

In this context, STEM readiness of Faculty of Education is very important, as STEM education has begun to be integrated into our curricula at all levels and its attributed importance is increasing each day. For this reason, it is very important that the Faculty of Education of one of the best universities in the country, is where in this position. Because the readiness level of this Faculty of Education, which belongs to one of the leading universities in the country, will provide us a chance to think about the status of the education faculties in the country in an indirect way.

Possible findings from this study will allow the necessary arrangements to be made in the educational faculties at current education reform process starting with the STEM integration to the school curriculum and continuing until the education system is renewed. Moreover, thanks to indirect findings of this study will allow the teacher candidates, who will apply the STEM applications that are integrated into the curriculum at their schools when they graduate, will be much more equipped and competent in this regard.

Finally, STEM education emerged from the US because of national needs and national policies of the country, but the needs of our country's education system may differ from the US. It will not be in our country's advantage to adopt an educational approach that is shaped in line with the dynamics and needs of another country. The right thing is to shape this approach in line with the needs of our system instead of taking it directly. In this study interviews were conducted with educational faculty members, who are in charge of the educational system of the country and the requirements of this system, and their views are taken. These views will be very helpful in the assessment of how we integrate STEM education into the existing education system, what kind of changes we have to go through and how we should do it. Therefore, besides the consequences related to STEM readiness of faculty, these views will be very important in integrating STEM into our education system by revising it in accordance with the needs of our country.

1.6 Assumptions of the Study

Two assumptions are made in this study. The first one is that participants have accurate information about STEM education and its related terms and have answered questions in this regard. The second one is that although participants have expressed their opinions on STEM education in interviews, they did not have a positive or negative prejudice about it before.

1.7 Limitations of the Study

There are three limitations at this study. The first limitation is that study covers just one university. However, it should be noted that this university has the most successful students in many provinces of the country. Although this university is one of the best universities in the country, the fact that this university is the sole subject of this study, this limitation prevents us to make broader judgments about Turkey. The other limitation is that although there are many faculty members in the faculty, I have interviewed with the ones who I thought would represent the departments, not all, within the time and scope of the study. I could interview with just one undergraduate student, one graduate students and one faculty member from nearly each department. The final limitation is that although I could interview with faculty members, I could not observe their lesson and collect data about them. At that point, their honesty is the key element for the result of that study.

CHAPTER 2

LITERATURE REVIEW

In this chapter, the concepts of readiness and STEM readiness will be emphasized and the role of the teacher in STEM education will be explained. Finally, the STEM framework that is developed by The New York City Department of Education (2015), which is the basis of this work, will be examined under 4 domains and its indicators.

2.1 Readiness

Readiness has very general definitions and often used for a different concept in the past in the meaning of being ready. There is also a lot of definitions on different topics in the literature. In order to better understand the STEM readiness concept, it is first necessary to understand what the concept of readiness is.

In a general meaning, readiness is the willingness, at the meaning of knowledge and skill, and ability, at the meaning of confidence and commitment, which an individual must have for overcoming to a given task. We cannot see readiness as characteristic of individual or evaluation of things like age, traits, values etc. of a person. It's just how ready an individual is to accomplish a task (Hersey and Blanchard, 1988).

2.1.1 Readiness of Student

In addition to the general meaning of readiness, it can be specified for students and for that aim, National Educational Goals Panel [NEGP] members generate new readiness definitions. According to that definition readiness includes five integrated and essential domains. These domains are language usage, emotional and social development, general and cognition knowledge, approaches toward learning, motor development and physical well-being (NEGP, 1993). However, this definition is missing because it does not explain how the children become ready or in which domains they have functioning for school.

Besides many definitions, we can view readiness in three categories. The first category is maturational readiness which is a natural process in which children go through stages at different rates (Ilg & Ames, 1972). It focuses on not chronological age in the Gesell theorist terms but developmental age (Freberg, 1991). The second one is school readiness and it is related to skills, knowledge and disposition needed to be successful in school (Kisker, 1992). The final one is the environmental readiness and it is related to active experiences that Piaget (1972) defines. Those experiences stimulate a natural developmental process of being ready to learn (Copple, 1990). The reason of that, the role of environment in readiness of individual is very important because of the prerequisite that is environment to be ready for him/her (Boyer, 1991; Graue, 1992).

2.1.2 Readiness of Teachers

There are other factors influencing readiness of teachers besides willingness and ability. Howe and Stubbs (2003) sorted these factors as work ability, family or personal life. While participants declared that their readiness is related to different things such as their position in the society, responsibilities, number of children. In the other study, the dependence of readiness of teacher is mostly on the training of them when compared to their personal things (Elkind, 2014).

There were also some other studies related to teacher readiness or the role of them in learning (Steele, Brew, Rees & Ibrahim-Khan, 2012; Windschitl, 2009). The common result of these studies is the relationship between the readiness of teachers and their strength and weakness. Their personal views about themselves are important at that part and if they think they are strength about that issue, they evaluate themselves ready.

In the study of Inan and Lowther (2010), the elements having an effect on laptop using of teacher at their lesson investigated. About the definition of readiness, they reach that conclusion, readiness can be considered as teacher’s own abilities and competencies for laptop using in their lessons. From that definition, we can generalize it to teacher’s own abilities and competencies of a related thing.

2.1.3 Readiness and Self-Efficacy

Self-efficacy concept is firstly described by Bandura (1997) as "beliefs in one's capabilities to organize and execute the courses of action required to produce given attainments" (p. 3). He also explains the beliefs about self-efficacy influence the outcome, the behavior, the achievement (Bandura, 1997). According to self-efficacy theory; if an individual has high self-efficacy belief, the possibility of success will be high and if low, success possibility is low. This is because self-efficacy affects one’s ability to be successful at something. It can be considered as initial push to accomplish task successfully (Bandura, 1977).

When we consider these definitions, we can see self-efficacy is very close to readiness’ ability aspect. Because, both emphasize that if a person has talent about something, then he believes that s/he will be good at it. Moreover, similar to readiness, we can accept self-efficacy as an indicator of opinion of teachers about themselves in the way of readiness (Cakiroglu, Capa-Aydin & Hoy, 2012). When we think about it within education context, teacher self-efficacy is foreground. If teachers’ self-efficacy is low, then they have difficulty in understanding and teaching (Cakiroglu et al., 2012). We can see the same situation at readiness, because if teachers think they are not ready, then they cannot have a successful learning and teaching process.

Despite these similar definitions, we can say that readiness differs from self-efficacy with willingness aspect. Because self-efficacy is focused only on ability, capability; readiness has broader meaning when compared to it. In addition, the readiness used in this study is clearly distinguishable from self-efficacy. Because it is evidence-based definition, not perceived-based. The questions addressed to the participants leave from the definition of self-efficacy, since they are related to what they do and plan in the lessons, rather than the question of how ready they feel.

2.2 NYCDOE STEM Education Framework

This framework is a tool that provides a structured approach to schools (high schools) that aim to apply and develop STEM education. It is not an evaluator or a judge, but it contains a checklist of systems, structures, and criteria in its content. This framework is based on working with other qualitative tools and guidelines and aims to create a STEM culture integrated with the current mission and vision of the school. This is done by shifting the disciplinary paradigm from interdisciplinary or multidisciplinary to transdisciplinary learning and instruction. These terms are visualized in Figure 6.

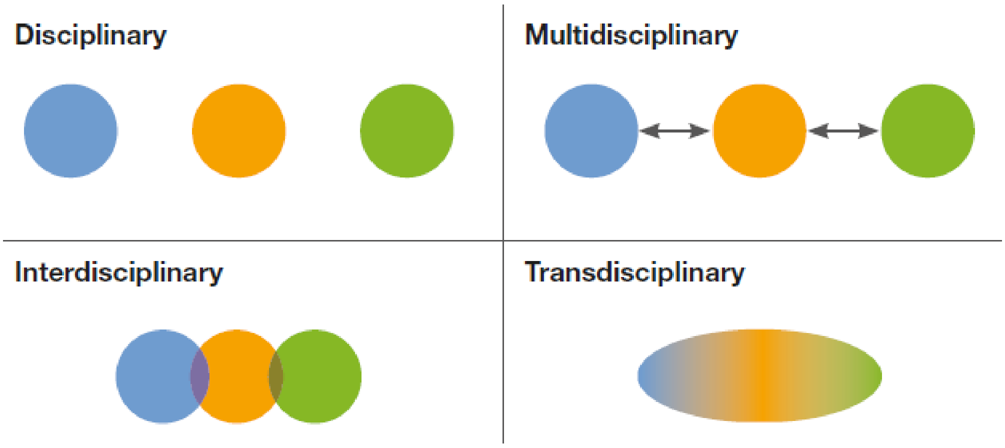

Figure 6 Disciplinary Visual From “NYCDOE STEM Education Framework”, by Carmen F., Phil W., Anna C., Linda C., 2015, http://schools.nyc.gov/NR/rdonlyres/DE2FC1DE-5FB8-474F-BD27D75FF70EF610/0/STEMframework_WEB1.pdf, copyright by New York City Department of Education.

This framework that based on the responsibilities of the school has 4 main domains. There are also some indicators with criteria that describing necessary conditions for maximizing the potential of domains. These criteria were stated clearly and explicitly. According to criteria, the readiness of each indicators will be evaluated as “Early”, “Emerging”, “Integrated” and “Fully Integrated”.

Because this framework was prepared based the high school, it is transformed according to university level adhering to domains and indicators. However, because the transformation process is related to the method of study, the detailed information about the criteria and ways of transformation is stated in methodology chapter. At that part, there are information related to just domains and indicators of framework, the criteria of them and they are explained in detail by categorizing below.

2.2.1 Domain I: School Vision and Structures for Success

This domain is related to vision, culture, program, and resources of school about STEM education. There are four different indicators based on these four subjects and these indicators are explained below.

2.2.1.1 STEM Mission and Vision

This indicator main subject is the mission and vision of the school. To be fully integrated at that indicator, STEM mission and vision of school should be established and integrated into school long term aims. All stakeholders have common consensus on that mission and vision. Moreover, the ultimate desire of the school should prepare students who are ready for the 21^{st} century and STEM. Finally, administrators and teachers are aware of the importance of problem-based learning and collaborative practices in terms of students.

2.2.1.2 STEM-centric Culture

The focus of this indicator is the integration rate of STEM to the school culture. The positive environment for risk taking and innovation among all stakeholders and emphasizing and encouraging students to failure and productive struggle in STEM education is some criteria of fully integrated evaluation. Moreover, understanding the importance of exploring the natural world and built by nearly all school staff, students, parents are the other criteria. There should be regular monitoring mechanism about STEM-centric culture quality at the school. In addition to that, most of the laboratories and classrooms at the school should be arranged to flat tables that having access to electricity and interdisciplinary and transdisciplinary works should be established at the school.

2.2.1.3 STEM Program Evaluation

As the name implies, this indicator is related to how rate STEM education implemented at the school curriculum and the relationship between it and STEM leadership team consisting of school administration, families, and all stakeholders. To be successful at that part, the school should be in process of implementation of STEM education to curriculum according to needs, progress and achievement of students and feedback from teachers. Besides the dynamics of that implementation, STEM leadership team should play a role at that process.

2.2.1.4 Budget/Management of Resources

It concerns the extent to which STEM education is taken into consideration in the use of the budget and management of resources. That indicator is associated with all the things related to funding such as discussions about sharing the cost with partners or other schools, finding grants or donations and STEM leadership team discussions related to finding long-term funding and resource needs of STEM program. Moreover, using current resources by considering STEM education or program is another important issue for that part.

2.2.2 Domain II: STEM Curriculum, Instruction, and Assessment

The focus of this domain is capacity of staff, quality of instruction, assessment types, school curriculum and the relationship between them and STEM education. There are four indicators again and these are explained in detail below.

2.2.2.1 Academic Rigor and Instructional Quality

This indicator includes some criteria related to the quality of instruction and academic rigor such as student-centered instruction, giving chance to students for articulating content and purpose of their work, providing high-quality support for underrepresented minorities, female students, struggling students and students with disabilities. Furthermore, teaching practices at the school should be compatible with the STEM mission and vision of the school at the first domain.

2.2.2.2 STEM-centric Curriculum

At that part, the rate of integration of STEM education into school curriculum is investigated. Instruction should be student-centered and STEM curricula can be changed and shaped according to needs of students. There should be also separated time both during and after school for integrating or applicating two or more STEM disciplines. There should be engineering design practices, technology integration and project-based learning during instruction. Besides these, giving real world problems to students and expect solutions from them by focusing STEM disciplines is the main thing at that indicator.

2.2.2.3 Authentic Assessment

Regardless of the content of the courses and their relationship with STEM, that indicator is concerned with their assessment types. To be successful at that part, teachers should use authentic assessment methods like portfolios, projects, journals, oral presentations etc. and make mostly performance-based assessment to their students. Finally, using cycles of learning by stakeholders and teachers is crucial with the aim of implementing, adjusting, reflecting, and sharing lessons learned.

2.2.2.4 Staff Capacity

Pedagogical and content knowledge of STEM and the capacity of teachers or other staff about STEM education is the main concern of that indicator. To get a fully integrated degree, there should be teachers having high STEM capacity at first. The other criteria are STEM content and pedagogical knowledge of teachers and sharing necessary information about STEM opportunities and programs among all stakeholders of school.

2.2.3 Domain III: Strategic Partnership

This domain is about the connection of school with other stakeholders like business partnership or communities. This connection is supplied by the way of strategic partnership with the aim of enhancing learning experiences of students in STEM education. It has just one indicator related to that and it is explained below.

2.2.3.1 STEM Partnerships

Main criteria for that indicator is establishing an effective and purposeful partnership with informal learning institutions, community-based organizations, and higher education schools with the aim of increasing learning experiences of students in STEM education. Moreover, the school should use and share information that taken from these institutions, organizations, or schools with all stakeholders via newsletters, websites, social media platforms or emails. Finally, there can be also other partnerships with other schools and STEM-centric organizations.

2.2.4 Domain IV: STEM College and Career Readiness

The main aim of this domain is to prepare students to STEM career and help them at that process by supplying necessary information and orientations.

2.2.4.1 STEM Pathway Preparation for Elementary School

This indicator focuses on a well-defined STEM education program that enhances students' early college awareness by preparing them for a required two or four-year STEM degree or a STEM career. Also, learning experiences that happen outside the school are also the important aspect of that part.

2.2.4.2 Access to STEM College and Career Opportunities for Middle and High School Students

Although that one is similar with the previous indicator in some ways such as preparing students to STEM career, the focus is to inform students and their families about STEM career opportunities through school activities, seminars or guidance counselor referrals. The responsibility belongs to school staff including administrators and teachers at that part. Beside career opportunities, informing students and families about the grants, scholarships and financial aids is another important issue.

2.2.4.3 Planning Student Outreach and Support for Pre-K-12 STEM Initiatives

Effective guidance about the applications and selection of colleges and schools to high, middle, and elementary school students and their families is the main concern at that indicator. Coordination of interacting STEM professional with students and families is the responsibility of the school.

CHAPTER 3

METHODOLOGY

In this chapter, the sections such as method of the study, the reason for selecting the method, the sample of the study, the reasons for preferring this sample, the process of converting the STEM Framework prepared for high school students to the university level, the data collection process, the analysis of the data will be explained in detail.

3.1 Method of the Study

The purpose of this study is exploring the readiness level of a faculty of education in Turkey for providing effective STEM education in terms of the STEM Framework prepared by NYCDOE (2015) by considering the ideas of elements of this faculty. Because although STEM education has been included in the MoNE report, started to be added to the school curriculum, and the ministry is considering reforming the education system, considering the STEM education; there is no study related to the readiness of faculties of education in Turkey in the literature as mentioned before.

Case study is chosen for that aim in this study. It is simply a study type of one or more cases within a defined system (Creswell, 2007). There are different opinions related to what the case study is. While some researchers (Denzin & Lincoln, 2005; Merriam, 1998; Yin, 2003) sees it as comprehensive research strategy, methodology or strategy of inquiry; case study for Stake (2005) is just choosing of researchers what they will be studied, not methodology.

Although there are several types of case study, there are two main categorization criteria which are the size of the defined case or case analysis's intent. Based on these criteria, three types of case study can be stated. These are single instrumental case study at which the focus of the researcher is on the concern or issue and s/he chooses one defined case for interpreting this issue, multiple or collective case study whose focus is the same as instrumental one, but the researcher chooses more than one case (Creswell, 2007). The final type is intrinsic case study in which the researcher’s focus is the case due to including unique or unusual situation (Stake, 1995).

Because the concern of this study is the issue which is the readiness of the education faculties and it includes one case, the specific method of the study is single instrumental case study. The reasons to be selected just one case are explained in the sample part.

The schematic outline of the methodology process that will be described in detail in subsequent sections is shown in figure 7.

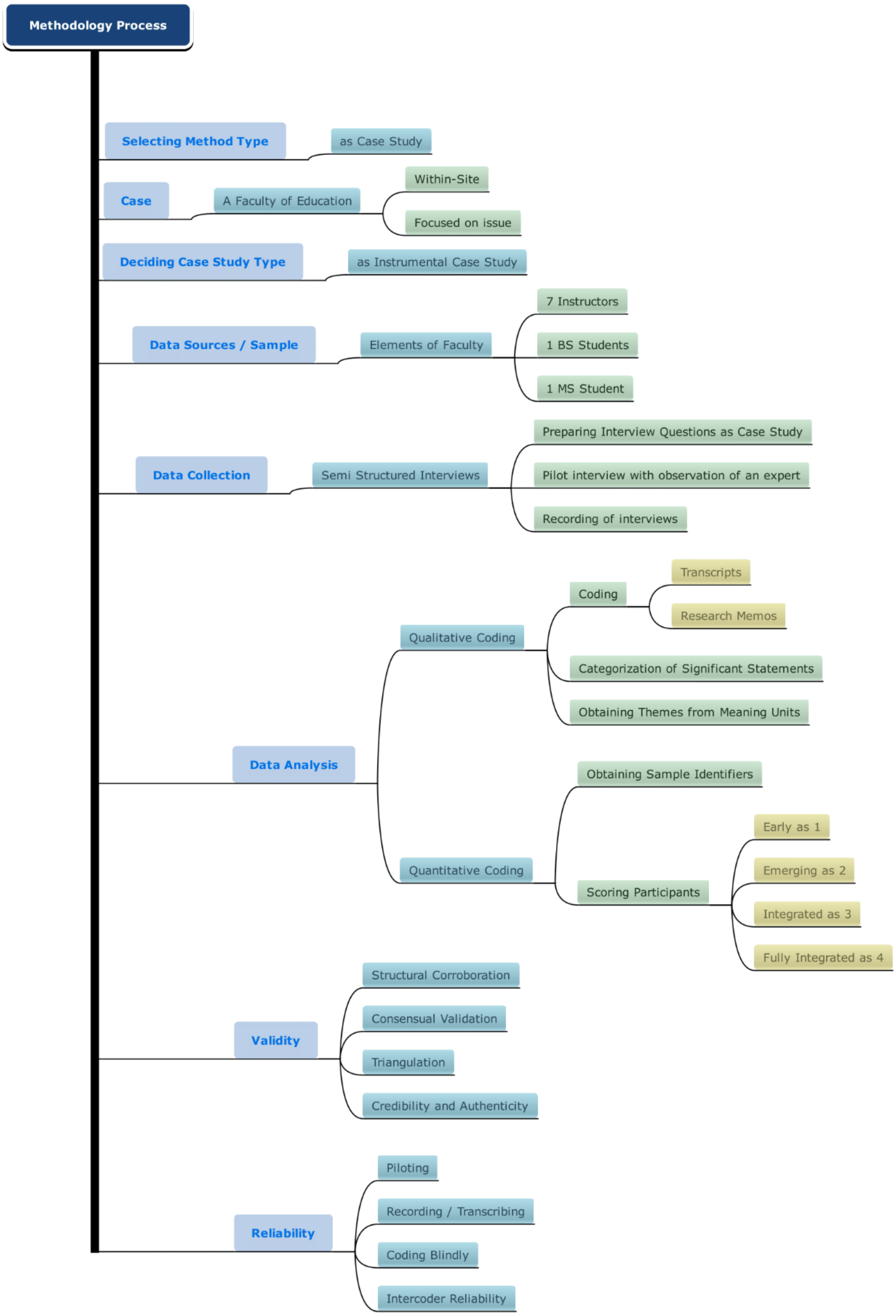

Figure 7 Schematic Outline of Methodology Process

3.2 Sample

In that study, the case is a faculty of education and the issue is the STEM readiness of them. In the case study, the most important criterion in case selection is to be able to choose the most appropriate case for research purpose (Jensen, Rodgers), 2001. Also, the selected case should be important, interesting, and researchable (Bennett, George, 1997). For these criteria, faculty of education is very suitable for being case of the study for two reasons. First, the aim is to explore the readiness of the faculty of education and due to that, case should be itself. Second, faculty of education is also important, interesting, and researchable.

As mentioned before, there is just one faculty of education at that study. Because data collection possibility and possible time that will be consumed during collection and analysis process have influence on that decision of selecting one case for study, it can be considered as convenience sampling (Creswell, 2007; Miles & Huberman, 1994; Yin, 2003). According to Patton (2002), it is the practice of "doing what's fast and convenient" (p. 228). This sampling method also belongs to purposive sampling technique.

Also, there are other factors besides those and before explaining, it is necessary to think about the history of STEM education in Turkey. Because this term is still can be considered as new even in US even though it is emerged from that country. So, this situation is far beyond the US in Turkey as expected. STEM education can be considered as brand-new in Turkey. This situation is supported by findings which are found in unpublished master thesis of Şatgeldi (2017), she obtained that major part of teachers are not aware of STEM education despite some of them having some knowledge related to it. In addition to that, most teachers who just use some applications on the smart board think implementing STEM education into their lessons.

So, if we consider these knowledge and findings that STEM education concept in Turkey is not defined and understood clearly, selecting to one of the best faculties in country will be logical. The faculty of education conducting study is one of the most successful ones in Turkey. According to ÖSYM (2017) placement statistics that base scores of nearly all departments of that faculty of education is at the top two of the list. It belongs to a state university in Ankara. This study can be expanded in the future according to results I obtained.

After deciding case, another important issue is obtaining sample size for the case study. Because after the researcher obtain the focus of the study, then s/he should decide the sample is whether single or multiple. At that point, intensity sampling method, which is one of the purposive sampling techniques, was decided to be used. Exploratory work and prior information is needed for using intensity sampling method (Patton, 2001) and I have both knowledge about the case before the study. Based on these information, I decided to interview the heads of departments, or the richest faculty member as a data source for that department, instead of the whole of the faculty members in the faculty. The same was valid for students, and one undergraduate and one graduate student who could provide rich data about the subject were involved in the study.

Although there is not a clear statement related to sample size at qualitative research at literature, there is a propose that sampling continued until the sense of saturation o researcher (Guest, Bunse, Johnson, 2006; Mason, 2010; Morse, 1995). In order to achieve saturation, the researcher needs to increase his familiarity with the answers given in the interviews. According to Bertaux (1981), the researcher learns a lot in the first few interviews and is really surprised but as the number of interviews increases, the researcher begins to recognize the patterns in the answers of the interviewees and begins to feel the answers in advance. This means that the researcher is now at the saturation level and there is usually no need for more interviews.

In this study, the sampling size was determined according to the saturation of researcher at the saturation. Besides this, the scope of the study was also taken into consideration and 9 participants participated in the study with the decision taken together in consideration of these two contexts. Participants of the study are 7 faculty members and 2 students from a faculty of education.

Faculty members were selected homogeneously based on one member from nearly each department of faculty. In this context, faculty members consist of dean of the faculty (and instructor at science education), one faculty member from science education department, one from mathematics education department, one from chemistry education department, chairs of computer education and instructional technology and educational sciences departments and vice chair (and instructor at physics education) of secondary education department. In addition to these, there are two students, one of who have an undergraduate degree and the other has a graduate degree. Both students are at their last semester.

There is no faculty member from early childhood education and foreign language education department. I choose not to early childhood education because I keep the boundaries of this study limited from elementary school to high school. Moreover, I also exclude foreign language education from this study because it is necessary to look at the readiness of STEM education in the main courses before foreign language courses in my idea.

For the permission of semi conducted interviews and, ethics approval was taken from the Graduate School of Natural and Applied Sciences (see Appendix A).

3.3 Data Collection

Semi structured interviews were selected to get best and most efficient data from the sample. Because, in the case of an interview with the right questions, the necessary data will be obtained about the domains in the STEM Framework from the participants, as well as their ideas about the STEM education which is not included in the framework or in the questions of the interview. Although the aim of this study is to measure the STEM readiness of the faculty of education, it is equally important to be able to obtain data on the ideas of participants about the STEM education and its implementation to Turkish educational system.

After data collection method were obtained, interview questions were started to prepare based on the STEM Framework. This process explained at 3.3.1 part below. At that step, I reach all participants and set a date with them for face-to-face interview.

I mentioned about the content of my study and questions but give no spoiler about them. At the beginning of the interview, I mentioned about the STEM education, STEM readiness and the STEM Framework I used shortly to the participants and got their permissions to record the interview as audio file to my cell phone.

According to Kvale (2006), the relationship between interviewer and interviewee is very important for a quality of interview. Because of that, I tried to keep caring, nonjudgmental, warm and make eye contact with interviewee. Nunkoosing (2005) points out that participants should reflect their opinions freely in the answers given to the questions in the interviews. I underline that these questions have not true or false answers and should only state their opinions and the situation about their department or faculty to all participants at necessary questions during interview for that aim.

Weis & Fine (2000) emphasize the importance of additional questions at the interview for obtaining the correct data. I asked some extra questions at the interview if it is necessary for getting the desired data. Also, after asking all the questions I prepared, I asked if there was anything to add to the participant in each interview. Lipson (1994) stated that privacy is an important criterion for the participants to be able to respond sincerely to questions. I also assured that this record could only be accessed by me and a few researchers for the aim of analysis before each interview to ensure this privacy. Interviews took an average of 30-40 minutes, with interviews that ended in 25 minutes or exceeded 1 hour.

3.4 Preparing Interview Questions and Transformation of STEM Framework

I prepare my interview questions based on the STEM Framework. Because that framework was prepared based on the high school level, I had to transform it into university level and I started with that process. As explained in detail at literature review chapter, there are four domains and their various indicators and detailed description of these domains and indicators will not be made again at that section. Only the process of converting these parts into university education and preparing the appropriate questions will be mentioned.

Before I started to prepare questions, I have read the framework a few times carefully, considering the domains, indicators, and evidences below them, to understand in depth. At that reading process, I took notes on what different domains might correspond to at university level. Then, I gathered these notes and prepare a draft related to it. After that step, I started to study with 2 experts. I completed the transformation of the framework at the end of one month's worth of work by making the necessary corrections every time considering the feedbacks I took at the interviews I made with these experts about the drafts that I prepared. At the end of the transformation process, the domains and indicators described before according to framework definitions have been converted to the new situations.

Domain I that is the school vision and structure for success is revised considering university and faculty dynamics and some changes were made at their indicators. At first indicator, STEM mission and vision, questions prepared for the aim to learn the ideas about STEM education, problem-based learning/collaborative practices and whether the department or faculty has STEM mission and vision. At the STEM-centric culture indicator, there were four different parameters questioned. These are the point of views of the instructors towards STEM education, the interdisciplinary or transdisciplinary treatment of the courses, project-based learning, engineering application and technology integration at the courses and design of the classrooms and laboratories in terms of STEM education. While at the third indicator, my only focus is on the STEM education during course program preparation. During the interviews I investigated for the basis of STEM education in the process of preparing the department or faculty course program and, if not taken, questioned whether there was a plan in this direction. At the budget/management of resources part, parameters related to budget usage on STEM education was investigated. Both the existence of a potential budget for STEM education and the attitude of department or faculty when there was a desire about the necessary tools related to STEM education were emphasized.

Domain II has 4 indicators again and all of them revised based on the aim of the study. At first indicator some criteria that is not compatible with faculty of education is omitted and focused on student-centered education and parallelism of instruction with STEM mission and vision at the first indicator of domain I. There are three criteria at second domain and first one is giving students real world problems and expecting them solution to these by using their knowledge about different disciplines. This is the important aspect at STEM education. Beside these, the other focus of questions are existence of STEM course and seminars, conferences, events about STEM education at department or faculty. Then, only issue that I focus at the third indicator was at what rate the authentic assessment methods were used in the lessons at the department or faculty. Fourth indicator was related to staff capacity and consist of all elements of school at the framework, but I investigated the rate of faculty members who can contribute students about STEM education and work with them at their thesis or dissertation.

There is just one indicator at domain III and its focus is the strategic partnership with some organization, institutes etc. related to STEM education and I have not changed much its focus. I tried to obtain the existence of any organization, ministry, workplace, community, university, organization and the number of project and activity done or will do with them. At the last domain, there were three indicators but none of them is directly related to university. When I get similar opinions at the interviews with experts, I decided to make a single indicator by blending the places where the three indicators would be converted into university level. So, at the new indicator at the name of STEM career readiness I focused on three parameters. First one is the number of seminars, presentations, and activities for the aim of mentioning career opportunities at STEM fields to students. Then, I questioned the number of project that is currently conducted or scheduled to be carried out related to STEM education at the department or faculty for the aim of attracting students about master or doctoral program. Finally, I focus on a master or doctoral program, a minor program or an elective course package that is available or planned for STEM education.

I have a draft of an interview questions with the end of the transformation process of framework based on the university and education faculty dynamics. Afterwards I made necessary corrections on the draft in line with the feedbacks I received in interviews with experts and then I made a pilot interview after I was sure that I was finalizing the questions. I made some revisions on my questions based on the feedback I got from the pilot interview. I did not need any elimination or addition to questions since the interview duration was nearly the same as I expected. However, I did not get the answers that I expected on some questions. So, I had some additions and revisions on them. Based on the answers I received, I thought it would be useful to create some additional sub questions that could be asked. At the end of these processes, the questions turn into final version with all the revisions and the approval of experts.

Although many of the questions were similar, there were 4 different types of interview questions because there were different types of interviewee at my sample (see Appendix B). Participants were divided into four categories: professors / assistant professors, faculty dean, head of Center for Science, Technology, Engineering, and Mathematic Education [BILTEMM] and students. While the questions were prepared based on their departments at professors / assistant professors, focus of the questions were on the faculty at the interview with dean. I also decide to prepare some unique questions for head of BILTEMM because nearly all participants gave me BILTEMM as answer at the domain III, strategic partnership part at their interview. It is also an important organization for faculty and I want to ask specific questions related to that center to head of it. I also eliminate some parts like budget/management of resources for students at the interview because that sections are not relevant to students.

3.5 Data Analysis

After I prepared interview questions and finish the data collection process, I started to analysis of these data. The audio recording of my interviews is the main data resources of mine. First, I transcribe all the interviews to the Word document right after the interview is done. I store this file without the name of participants for their confidentiality and make more than two copies of them for backing up as Davidson (1996) suggested. Moreover, Plummer (1983) stated that more than one data sources such as notes, or records is better for quality of study. For that aim I also use research memos at my study. These are the ideas of mine about the interview and participant right after the interview. Although according to Cresswell & Plano Clark (2007), this technique is very useful for grounded theory method, the memos that I kept made a lot of sense to me when I started to analyze the data. Because while I keep going to write these memos, they were turning to unofficial and uncategorized themes or meaning units in a time.

After I got my all data, I pass the analysis process. At that process, the ideas about methodology are very similar to each other in literature. Wolcott (1994) propose a method starting with highlight certain information in description and going on with identifying patterned regulations and contextualizing in framework from literature, finishing with displaying finding with visuals like tables, charts. When looking at the study of Baskarada (2014), it includes a collection of general information related to how conduct a case study and at the analysis part although he mentioned about different analysis methods like word count analysis, classical content analysis etc., the main steps to follow when analyzing is the same. Moreover, the similar pattern can be seen at the other studies (Beekhuyzen, Nielsen & von Hellens, 2010; Leech, Onwuegbuzie, 2011) and this pattern can be sorted as coding data into meaning units, then categorize these meaning units and finally creating themes based on the similarities or connection between these categories. Although there are some differences at the coding part, the process is identical.

Then, I passed to coding part and before starting, I read all transcripts and research memos in their entirety several times as Agar (1980) suggested, for the aim of immersing details, getting a sense of interview as whole before starting to break it into parts. Constant comparative method (CCM), that is coming out with the aim of creating of grounded in the data theories (Boeije, 2002; Glaser, Strauss, 1967) and working inductively to “discover the latent pattern in the multiple participant's words” (Glaser, 2002, p. 2), is one of the terms I use in this phase.

I separated the coding part into two parts which are classical or qualitative and quantitative one. There are basically three types of coding which are descriptive, topic and analytical coding for qualitative part. While descriptive one is pertaining with broad topics which the study conductor wishes to develop prior before his/her observations and interviews (Morse & Richards, 2002), topic coding is relating with issues that only coming out during analysis (Beekhuyzen et al., 2010). In analytical coding, the encoded data is presented in an abstract frame in categories that are more abstract than the transcripts (Baskarada, 2014).

Besides these, there are other qualitative data analysis techniques suggested by Leech & Onwuegbuzie (2011). Some of them are key word in context analysis that is identifying usage of word in context with other words and word count analysis that focuses on the importance of the words using more frequently. After examining all these analysis method, I decided to use analytical coding method at the first step of my coding part. It is very suitable for my study because STEM is not still clear in Turkey, there is high possibility to get more abstract categories and themes related to our framework.

At the second and quantitative part of my coding, I prefer to use content analysis method. Because content analysis method was seen as the quantification of qualitative data by many researchers (Kalpan, 1943; Berelson, 1954). According to Kutalunga, Haigh, Amaratunga & Haigh (2007), it can be used for the aim of quantifying themes or concepts, words, and characters from the text. Moreover, organization and breakdown of large amounts of data into codes or categories such as phrases, themes, words, sentences, or concepts is possible with content analysis (Junginger, 1996; General Accounting Office, 1996). Besides these, Zhang and Kuo (2001) also proposed that categories' properties like occurrence or frequencies can be identified systematically with content analysis.

There are four main types of content analysis which are word count, conceptual content, referential and prepositional analysis (Krippendorf, 2004). Conceptual content analysis, also known as the thematic analysis, is suitable for the analysis of this study. Because in this type of analysis, the data is analyzed to check the existence of the concept or theme (Colorado State University, 2006; Krippendorf, 2004). In this part of the analysis my aim is to check whether there are identifiers that I am looking for in the answers given at the interviews.

These identifiers were related to indicators of framework and prepared based on this framework and the answers of participants for each four category that are early, emerging, integrated and fully integrated. Then, I score each indicator of each participants as 1 for early, 2 for emerging, 3 for integrated and 4 for fully integrated. The coding method used in this part of the work in this way is the deductive coding method defined by Stemler (2001), Mayring (2000) and Bernard (2000) as the coding type based on the pre-generated categories and codes based on the theory. This is consistent with the categorization of the dominant concept/themes in the data into codes that Franzosi (2004) proposed and the idea of collecting similar concepts under same category that Swan (1997) proposed at their studies.

3.6 Validity and Reliability

There are some techniques used for ensuring the validation and reliability of the study. These techniques and strategies is explained at below parts.

3.6.1 Validity Strategies

There are many terms that can used at literature instead of validity and some of them are internal validity, external validity, reliability, objectivity (LeComptre & Goetz, 1982), credibility, transferability, dependability, confirmability (Lincoln & Guba,1985), structural corroboration, consensual validation, referential adequacy, ironic validity (Eisner, 1991), paralogic validity, rhizomatic validity, voluptuous validity and situated/embedded (Lather, 1993).

First, I used two strategies of Eisner (1991) proposed about validity and these are structural corroboration and consensual validation. While structural corroboration is relating multiple types of data for the aim of contradict or support interpretation, consensual validation is related with the opinions of others, consensus among ideas. For structural corroboration, before making sure the meaning units by supporting it with other evidences like research memos of participants, their attitude about that issue etc., I did not code it. Also, about consensual validation, after my coding parts is done I compared it to others' and discuss them about these comparisons.

Then I used triangulation method that is suggested by many researchers (Leather, 1991; Perakyla, 1997) and intended with more than one data sources and made interview with students besides instructors for obtaining triangulation of this study. Because although instructors give their own answer, I asked similar questions to students and compared them for getting valid result. Moreover, Angen (2000) suggested that substantive validation that means understandings derived from other sources and one's own understandings of the topic and the process of documentation of that. For supplying that validity types, I tried to make self-reflection during the data collection and analysis process. According to that reflection, I tried to keep stable my attitude toward the situation.

Furthermore, credibility and authenticity suggested by Whittemore, Chase & Mandle (2001), which means reflecting of accurate interpretation of meaning of participants by results and existence of different voice. In the study I give place to different voices at the analysis part by taking ideas of both other researchers and some experts. Also, I tried to make interpretation of participants' meaning at the study by making transcripts at the same day with interview for not to miss an important issue, keeping research memos and taking ideas of other researchers during this process. Beside these strategies, I also tried to be careful during the interviews. I tried to provide the suitable environment for the participants to freely express their ideas, instead of specifying my own ideas and influencing them, I tried to keep listening and I always ask them for extra questions or something they want to add so that they can identify things they might have forgotten or missed.

3.6.2 Reliability Strategies

Reliability can be obtained in the qualitative studies with several ways (Silverman, 2005). First step for reliability is conducting pilot studies for testing the way of questioning and its structure (Eisenhardt, 1989). Then, recording data mechanically at good quality by using tape recorder or other tools and transcribing of it is another reliability strategies (Nair & Riege, 1995). Moreover, I try to make the coding part blindly that means doing it without any expectations (Cresswell, 2007). Finally, the most important reliability strategy is intercoder reliability based on the analyzing of data by multiple researchers. Two researchers coded the data with me simultaneously and after the coding part we carried out the discussions about the analyzing part. After all the discussions and agreement on the same subject, the coding part is done.

CHAPTER 4

RESULTS AND DISCUSSION

In this chapter the results obtained at the coding part is presented. As I mentioned above, there is two coding parts at the study and due to that, the results are presented at two sections. The aim of the first coding part was investigating the readiness level of faculty of education based on STEM Framework for each domain and their indicators and conceptual content analysis method was used for that.

Besides these scores, the themes that emerged from the answers given in the interviews obtained with the analytical coding method are the other section of my results. All these results are presented in the following sections together with images such as tables, lists or figures. Discussions of results are also included in this chapter.

4.1 STEM Readiness Level

Conceptual content analysis method is used as deductively in this section. In this context, sample identifiers of indicators of STEM Framework were obtained at first. While the sample identifiers were determined, both the Framework and the participants' responses to the interviews were considered. Transformed version of Framework -transformation process was mentioned at previous chapter- was used, not the original version prepared for high school students.

4.1.1 Sample Identifiers of Each Domain

All the identifiers were obtained according to both the content of domain or indicator and the answers of participants. These are prepared for the 4 readiness levels which are early, emerging, integrated and fully integrated. All the related citations and sample identifiers are listed below separated by indicators under different titles.

4.1.1.1 Identifiers of Domain I

First indicator is STEM mission and vision. At the interviews, participants gave various answers to my questions and some of them are;

"STEM is not included in the mission and vision of the department/faculty."

"There is no STEM expression in the mission and vision of the department/faculty, but there are values that are parallel to STEM education."

"While some department/faculty members care about STEM education and problem-based learning, while others are not in this opinion."

Based on the answers of the participant, two identifiers were obtained for each readiness level and coding done according to them as you can see at Table 2.

Table 2 Identifiers of STEM Mission and Vision Domain (1.1)

Readiness	Identifiers
Early	- Faculty/department does not have STEM mission and vision and is not prepared to educate students according to 21st Century skills. - None of the faculty/department members is aware of the importance of STEM education and have problem-based learning / collaborative practice.
Emerging	- Faculty/department has part of STEM mission and vision and is partially ready to prepare to educate students according to 21st Century skills. - Some of the faculty/department members is aware of the importance of STEM education and have problem-based learning / collaborative practice.
Integrated	- Faculty/department has almost STEM mission and vision and is almost ready prepared to educate students according to 21st Century skills. - Many of the faculty/department members is aware of the importance of STEM education and have problem-based learning / collaborative practice.
Fully Integrated	- Faculty/department clearly has STEM mission and vision and is fully ready to educate students according to 21st Century skills. - All the faculty/department members are aware of the importance of STEM education and have problem-based learning / collaborative practice.

Then, at the second indicator, STEM-centric culture, there are many various citations from participants' interviews are. Some important answers among them represented below;

"The vast majority of faculty members are positively approaching to STEM."

"Most of our courses are interdisciplinary. But I cannot say the same about the transdisciplinarity of the courses."

"There is no interdisciplinary or transdisciplinary at our department courses."

"Technological tools used in our lessons but I cannot say these are technology integration."

"Engineering applications are not included in our courses."

"Technology integration is included at some of the courses in the department."

"Engineering applications used in our courses but the ratio of them is not high compared to all courses.

"Our current class or laboratories are eligible for STEM education."

"Our current class or laboratories are not eligible for effective STEM education."

"A new STEM laboratory should be designed, we have not now."

Based on the answers of the participant, three identifiers were obtained for each readiness level and coding done according to them as you can see at Table 3.

Table 3 Identifiers of STEM-centric Culture (1.2)

Readiness	Identifiers
Early	- The atmosphere of the faculty / department is not suitable for STEM education and the point of view of the teaching staff towards STEM education is not positive. - None of the faculty/department courses are interdisciplinary or transdisciplinary. - There is project-based education / engineering applications / technology integration in none of the faculty / department courses. - None of the classrooms / laboratories in the faculty / department have been designed in accordance with STEM education.
Emerging	- The atmosphere of the faculty / department is partially suitable for STEM education and the point of view of the teaching staff towards STEM education is not positive. - Some of the faculty/department courses are interdisciplinary or transdisciplinary. - There is project-based education / engineering applications / technology integration in some of the faculty / department courses. - Some of the classrooms / laboratories in the faculty / department have been designed in accordance with STEM education.
Integrated	- The atmosphere of the faculty / department is almost suitable for STEM education and the point of view of the teaching staff towards STEM education is not positive. - Many of the faculty/department courses are interdisciplinary or transdisciplinary. - There is project-based education / engineering applications / technology integration in many of the faculty / department courses. - Many of the classrooms / laboratories in the faculty / department have been designed in accordance with STEM education.
Fully Integrated	- The atmosphere of the faculty / department is fully suitable for STEM education and the point of view of the teaching staff towards STEM education is not positive. - All the faculty/department courses are interdisciplinary or transdisciplinary. - There is project-based education / engineering applications / technology integration in all the faculty / department courses. - All the classrooms / laboratories in the faculty / department have been designed in accordance with STEM education.

At the STEM program evaluation indicator, some answers of the participants are;

"Current program was not prepared based on STEM education, but we have preparations related to these issue at the new one"

"Our program, which will be implemented as of September 2018, was designed entirely based on STEM education."

"As STEM is a new concept, we have not taken it into account when preparing our program, but maybe there are new regulations about it."

Based on the answers of the participant, one identifier was obtained for each readiness level and coding done according to them as you can see at Table 4.

Table 4 Identifiers of STEM Program Evaluation (1.3)

Readiness	Identifiers
Early	- The faculty/department program is not prepared or planned to be based on STEM education.
Emerging	- The faculty/department program has been partially prepared or planned to be partially based on STEM education.
Integrated	- The faculty/department program has been partially prepared or planned to be almost based on STEM education.
Fully Integrated	- The faculty/department program has been partially prepared or planned to be fully based on STEM education.

At the final indicator of domain I, budget/management of resources, some of the citations of participants from their interviews are;

"Our budget is spent in the direction of those momentary needs, we do not have a budget for a specific category."

"We do not have a budget on STEM education, but if this is needed, the current budget can be used in this direction."

"A request for materials to be taken in relation to STEM education is welcomed."

Based on the answers of the participant, two identifiers were obtained for each readiness level and coding done according to them as you can see at Table 5.

Table 5 Identifiers of Budget/Management of Resources (1.4)

Readiness	Identifiers
Early	- No part of the faculty/department budget has been allocated for STEM education. - Requests for equipment, technology, or necessary tools on STEM education on STEM education is considered negative.
Emerging	- Small part of the faculty/department budget is allocated for STEM education. - Requests for equipment, technology, or necessary tools on STEM education may be considered positively.
Integrated	- Average part of the faculty/department budget is allocated for STEM education. - Requests for equipment, technology or necessary tools on STEM education are highly likely to be considered positive.
Fully Integrated	- High proportion of the faculty/department budget is allocated for STEM education. - Requests for equipment, technology or necessary tools on STEM education are strictly considered positive.

4.1.1.2 Identifiers of Domain II

At the domain II, there are again four indicators and at the first one, academic rigor and instructional quality, the citations were very similar to each other.

"Education is student centered at our courses except for some theoretical ones."

"Though more classical methods are preferred for small classes, as student is getting closer to graduation, the student-centered education become more preferred."

"Our education matches with the STEM mission and vision of us."

Based on the answers of the participant, two identifiers were obtained for each readiness level and coding done according to them as you can see at Table 6.

Table 6 Identifiers of Academic Rigor and Intructional Quality (2.1)

Readiness	Identifiers
Early	- No part of the faculty/department education is given as student-centered. - None of the faculty/department courses overlap with the STEM mission and vision in 1.1.
Emerging	- Part of the faculty/department education is given as student-centered. - Some of the faculty/department courses overlap with the STEM mission and vision in 1.1.
Integrated	- Almost all the faculty/department education is given as student-centered. - Many of the faculty/department courses overlap with the STEM mission and vision in 1.1.
Fully Integrated	- All faculty/department education is given as student-centered. - All faculty/department courses overlap with the STEM mission and vision in 1.1.

At STEM-centric culture indicator, there were various answers to questions at the interview and some of them are;

"In almost all our courses, we give projects to students over real life examples like these and expected products from them."

"There are a few lessons on STEM education, and a few are planned to be opened."

"There has been no activity on STEM education until now, usually short seminars within the course."

"There is no practice in the way of giving students real world problems and expecting solutions from them. It is not suitable for the courses at our faculty."

"There are activities on STEM education and attendance to these events is also intense."

Based on the answers of the participant, three identifiers were obtained for each readiness level and coding done according to them as you can see at Table 7.

Table 7 Identifiers of STEM-centric Culture (2.2)

Readiness	Identifiers
Early	- There is no course, in which real world problem is given to students and asked from them to produce solution to it according the synthesis of STEM, at the faculty/department. - There is no course on STEM education in the faculty/department. - No seminar, conference, or activity were organized about STEM and STEM education by faculty/department.
Emerging	- There are a few courses, in which real world problem is given to students and asked from them to produce solution to it according the synthesis of STEM, at the faculty/department. - There are a few courses on STEM education in the faculty/department. - A few seminars, conferences, or activities were organized about STEM and STEM education by faculty/department.
Integrated	- There are average number of courses, in which real world problem is given to students and asked from them to produce solution to it according the synthesis of STEM, at the faculty/department. - There are average number of courses on STEM education in the faculty/department. - Average number of seminars, conferences, or activities were organized about STEM and STEM education by faculty/department.
Fully Integrated	- There are many courses, in which real world problem is given to students and asked from them to produce solution to it according the synthesis of STEM, at the faculty/department. - There are many courses on STEM education in the faculty/department. - Many seminars, conferences, or activities were organized about STEM and STEM education by faculty/department.

At the third indictor, authentic assessment, there were similar answers to each other and some of them are;

"We use authentic assessment methods at almost all of our courses."

"We use all assessment methods including authentic, classical ones etc. by combining them according to content of the course."

Based on the answers of the participant, one identifier was obtained for each readiness level and coding done according to them as you can see at Table 8.

Table 8 Identifiers of Authentic Assessment (2.3)

Readiness	Identifiers
Early	- Authentic assessment methods are not preferred in any of the faculty/ department courses.
Emerging	- Authentic assessment methods are preferred in some of the faculty/ department courses.
Integrated	- Authentic assessment methods are preferred in almost all faculty/ department courses.
Fully Integrated	- Authentic assessment methods are preferred in all faculty/ department courses.

Last indicator of second domain is staff capacity and some of the citations of the participants related to that are;

"All of our faculty members can work on STEM education."

"I can say that a few of our 10 faculty members in our faculty are competent in this matter."

Based on the answers of the participant, one identifier was obtained for each readiness level and coding done according to them as you can see at Table 9.

Table 9 Identifiers of Staff Capacity (2.4)

Readiness	Identifiers
Early	- There are no faculty members in the faculty/department that students can work on STEM education.
Emerging	- There is a low number of faculty members in the faculty/department that students can work on STEM education.
Integrated	- There is an average number of faculty members in the faculty/ department that students can work on STEM education.
Fully Integrated	- There is a high number of faculty members in the faculty/ department that students can work on STEM education.

4.1.1.3 Identifiers of Domain III

At the only indicator of third domain, STEM partnership, there are various answers of participants and some of them are;

"We do not have any strategic partnership on STEM education."

"I can illustrate BILTEMM in this regard."

"We are in partnership with some high school which is related to this internship, but not with STEM."

Based on the answers of the participant, two identifiers were obtained for readiness levels and coding done according to them as you can see at Table 10.

Table 10 Identifiers of STEM Partnership (3.1)

Readiness	Identifiers
Early	- There is no institution, ministry, organization, or community etc., for which a strategic partnership is carried out/planned for the development of STEM education.
Emerging	- There are a few institutions, ministries, organizations, or communities etc., for which a strategic partnership is carried out/planned for the development of STEM education. - There is little coordination with these organizations and there is a low number of projects, activities, partnerships carried out together.
Integrated	- There are average number of institutions, ministries, organizations, or communities etc., for which a strategic partnership is carried out/planned for the development of STEM education. - There is partially coordination with these organizations and there is a average number of projects, activities, partnerships carried out together.
Fully Integrated	- There are many number of institutions, ministries, organizations, or communities etc., for which a strategic partnership is carried out/planned for the development of STEM education. - There is fully coordination with these organizations and there is a high number of projects, activities, partnerships carried out together.

4.1.1.4 Identifiers of Domain IV

Three indicators were combined as mentioned at previous chapter and the new and only indicator become STEM career readiness. Some citations of participants related to that domain are;

"There is no need for master and doctoral programs for STEM education, but a minor program can be considered."

"It cannot be said that there are many activities related to STEM."

"We have projects that are related to STEM, and most of our projects are planned to be done."

"We have an elective course package relevant to STEM education."

Based on the answers of the participant, three identifiers were obtained for each readiness level and coding done according to them as you can see at Table 11.

Table 11 Identifiers of STEM Career Readiness (4.1)

Readiness	Identifiers
Early	- There is no seminar, presentation, or activity to discuss the career opportunities of the STEM in the faculty/department students. - There is no project in the STEM education to attract faculty/department students to graduate education. - The faculty/department is planning an elective course package related to STEM education.
Emerging	- There are low numbers of seminars, presentations, or activities to discuss the career opportunities of the STEM in the faculty/department students. - There are low number of projects in the STEM education to attract faculty/department students to graduate education. - The faculty/department is planning a minor program related to STEM education.
Integrated	- There are average numbers of seminars, presentations, or activities to discuss the career opportunities of the STEM in the faculty/department students. - There are average number of projects in the STEM education to attract faculty/department students to graduate education. - The faculty/department is planning a master program related to STEM education.
Fully Integrated	- There are high numbers of seminars, presentations, or activities to discuss the career opportunities of the STEM in the faculty/department students. - There are high number of projects in the STEM education to attract faculty/department students to graduate education. - The faculty/department is planning a doctoral program related to STEM education.

4.1.2 Scores of Each Domain

After all these steps were done, scoring process of coding started. At these parts, scoring was done 1 for early readiness level, 2 for emerging readiness level, 3 for integrated readiness level, and 4 for fully integrated readiness level. Results were kept at a list that separated categories for each indicator. There are half numbers at the list that means answer of the participants scored differently for different identifiers at the indicator having more than one identifiers.

4.1.2.1 Scores of Domain I

The score list of the domain I is included at Table 12.

Table 12 Scores of Domain I

Departments	1.1 STEM Mission and Vision	1.2 STEM centric Culture	1.3 STEM Program Evaluation	1.4 Budget Management of Resources	*Average*
Faculty Deanery	3	2,5	3	2,5	*2,8*
Science Education	2	2	2	2,5	*2,1*
Mathematics Education	2	1,5	2	2,5	*2*
Educational Sciences	2	1	1	2,5	*1,6*
Physics Education	2	2	1	2,5	*1,9*
Chemistry Education	1	2	1	2,5	*1,6*
CEIT	3	3	4	1	*2,8*
Instructors Average	*2,1*	*2*	*2*	*2,3*	*2,1*
B.S. Student	1	1	1,5	-	-
M.Sc. Student	1	2	2	-	-
Students Average	1	1,5	1,8	-	*1,4*

According to results, we can say that the education faculty is emerging at the STEM readiness level. Many interpretations can be made depending on the results. While faculty manager sees his/her faculty can be considered as ready at nearly integrated level with 2,8 averages about vision and structures for success. In his/her idea, faculty is nearly ready for STEM education and there are studies conducting or planning to conduct related to that. CEIT and science education departments can be considered the readiest ones at the faculty with the averages of 2,8 and 2,5. However, we cannot say the same thing for chemistry education and educational sciences department. Because they both have 1,6 averages of the indicators of domain I.

Regarding the indicators one by one, we can say that most departments evaluate themselves as emerging in this regard on the first indicator STEM mission and vision. While CEIT department and the deanery of the faculty assess themselves at the higher level, the integrated level, the chemistry education department sees themselves at the lowest level, early. By looking at the general average of the STEM Mission and Vision indicator, it can be said that the faculty is relatively ready for this. In addition, most interviewees reported that the work being done on this topic was and will be at a better level. If we come out of the results and said, we can predict that faculty will be ready about these issues in the future. But it is also clear that the chemistry education department should take urgent steps in this regard. Even though the department and the deanship are sufficient in this respect, it is not the same thing for the students to say about the reflections of this situation to them. The two students I interviewed assessed their faculties at an early level, which seemed insufficient in this regard.

In the second indicator evaluating whether the departments and faculties had a STEM-based culture, the faculty average 2 was again emerging. In this regard, the CEIT department and the deanery of the faculty became the foreground again with the averages of 3 and 2,5. Although most departments have achieved a certain average in this regard, and some have managed to outdo it, the mathematics education, and educational sciences themselves have not considered it in a sufficient level. Based on what is described in the interview, it can be assumed that mathematics education can be said to be in this endeavor and be in better shape. But I cannot say the same for educational sciences.

If I mention the general impression of what is said in the interviews, I can say that most of the faculty members in the faculty are positive about the STEM education. Most of the courses are interdisciplinary, especially in some departments, but only a few departments do not focus on them. But I also need to mention that departments are not very active about transdisciplinary. Although most of the courses includes technology integration, almost no engineering applications are involved. It can be said that project-based education is also in the minority. There is no class or laboratory built on STEM education in any of the departments, but some departments think that the existing laboratories are sufficient for that usage. The issue that the departments share is the necessity of establishing a new STEM laboratory, but there is no clear thing in the meantime.

In addition, the student interviews have a score average of 1.5, which is lower than the scores of the instructors but there is not much difference between them. The difference is understandable if we evaluate this issue by considering some things that are currently in the planning stage but not reflected in the students. Although the level of readiness of the faculty is 2 for the second indicator, this score will increase as the engineering applications start to take place and the rate of project-based learning with the planned courses to be opened in the interviews. In addition to these, if sufficient budget and space is available, the faculty will be enriched in this sense with a planned STEM laboratory.

In the STEM Program Evaluation indicator, the faculty average was again 2. But this is not a very homogeneous distribution. That is, the three departments, educational science, physics education and chemistry education, evaluate themselves in the most insufficient level. This shows that while the programs of the departments are being prepared, STEM education was not taken as basis and there will be no change planned in this direction. While the rest of the departments have been informed that they have plans to make revisions in their programs in this direction, CEIT department stated that the new program, which will be used by September 2018, is based on STEM education. The average score of the students in this regard is almost the same as that of the instructors for this indicator. When considering these scores and interviews, it is necessary to say that there are some departments relating to this issue but 3 departments with scores of 1 are inadequate about that.

On the budget side, we can say that every department except the CEIT, which leads at all other indicators until now, gave the same answer. All the interviewees said that the specific budget on STEM education has not been separated until now. However, all departments except CEIT, said that they can provide necessary budget if there is a demand related to STEM education. The CEIT department states that they have a very limited budget in this regard and that even the necessary materials to be taken can only be obtained with the support of their own projects. The reason for the majority of the scores being 2.5 was scored as 1 because it was not a specific budget, and 4 as it could be separated if necessary. Since this was an issue independent of the students, they were not asked any questions about this indicator. The fact that all departments outside one department can provide the necessary budget in case of need is a sign that the issue is in sufficient level.

If we look at the general average of all indicators of domain I from all departments and faculty, it is 2.1. According to this result, we can say that the vision, culture, program, and resources of the education faculty studied in the study are relatively ready for STEM education. Looking at the average scores, it is obvious that the departments of educational sciences and chemistry education, which are two departments behind the average general faculty, should do something and revise their plans about this issue. Another important point to note is that the self-evaluation of the faculty average is at 2.1, while the students' assessment of this situation is 1.4. As I mentioned earlier, although this difference seems to be closing if the planned things are started to be done, some developments in theory should be put into practice as well.

4.1.2.2 Scores of Domain II

You can see scores of domain II from Table 13.

Table 13 Scores of Domain II

Departments	2.1 Academic Rigor and Instructional Quality	2.2 STEM-centric Culture	2.3 Authentic Assessment	2.4 Staff Capacity	*Average*
Faculty Deanery	3,5	2	4	3	*3,1*
Science Education	2	2	3	2	*2,3*
Mathematics Education	2	2	3	2	*2,3*
Educational Sciences	3	1	3	2	*2,3*
Physics Education	3	1	3	2	*2,3*
Chemistry Education	2	1	3	2	*2*
CEIT	4	3	4	3	*3,5*
Instructors Average	*2,8*	*1,7*	*3,3*	*2,3*	*2,5*
B.S. Student	2	1	4	2	-
M.Sc. Student	3	2	3	2	-
Students Average	2,5	1,5	3,5	2	*2,4*

In the second domain, which focuses on the curriculum, teaching and assessment stages, the faculty average is higher than in the first domain. The average of the domain with 4 different indicators in the faculty is 2.5, while the student average is 2.4. Although STEM-centric culture results, which is the second indicator, reduce the average for most departments, we can say that the results are much more satisfactory for the remaining 3 indicators. To make more useful inspections, we will examine these indicators separately, as in the previous section.

The first indicator is mainly concerned with the extent to which the education given is student-centered. In addition to this, the compatibility of the courses given with the STEM mission and vision are examined. Based on the general average of the faculty 2.8, we can say that this result has positive meaning in terms of STEM education for the faculty. Though the most prominent department is CEIT, the educational sciences and physics education departments are well regarded. However, science education, mathematics education and chemistry education departments are behind this average with 2 points. Although their score is not very low, it is also obvious that they need to improve themselves. Another interesting detail at the results is that there is nearly 1-point difference between average of the faculty and the score of deanery. This result may show us that the departments at the faculty evaluate themselves behind the dean about that issue. Another possible reason may be that the things planned by the deanship could pull this average even higher. There is very little difference between the student scores and the faculty average. This shows us that the efforts of the faculty are reflected in the students.

The scores on the STEM-centric culture indicator, in which the existence of STEM education at faculty cultural has been questioned, are relatively low. In this indicator, where three departments see themselves as extremely inadequate with 1 point, 2 departments evaluate their readiness level at the emerging level with 2 points. While the Deanery was also evaluating faculty at the emerging level, the CEIT department succeeds to be the leading section again in this regard with 3 points. If we take into account the 1.5 point of the students, we can indicate that the faculty is not ready about this issue.

At the beginning of the thing that reduces the score in this regard is the negative answers given about the usage of approaches that, giving real world problems to student, and expecting solution from them with STEM synthesis. While most instructors indicate that these kinds of things are not done in class, some even have said that these things are not the work of their own, but the work of the engineers. They said these applications would be appropriate done in engineering or arts and science faculties, not in education faculties. This attitude about such approaches which are very important for STEM education does not have positive meaning on behalf of the faculty. Another important factor that lowers this score is the small number of activities on STEM education. Also, no plans were mentioned about organizing such activities in the interview. Finally, the few numbers of lessons currently offered on STEM education have reduced this score. However, there is no need to take a negative attitude in this regard as it seems that the number of these courses will gradually increase.

In the third indicator about assessment techniques, the faculty average is very high with a score of 3.3. While CEIT department declared that they used authentic assessment techniques in all their courses and assessed them as fully integrated, all other departments indicated that they saw themselves at an integrated level with 3 points. Departments that evaluate themselves with 3 points say that they do not use these techniques in only a few theoretical courses. Students' average of 3.5 points also indicates that this situation is reflected in them too much and proving that faculty is completely competent about assessment issue.

On the last indicator of the second domain, all departments outside of CEIT see themselves at emerged level. The Dean, on the other hand, described the faculty as having an integrated level of 3 points. Because STEM education is a very new concept, each department has a few teaching staffs to study on this subject, but the number of specialized teaching staff members is very low. For this reason, although most departments see the faculty members at the capacity to do so, they do not decide to that based on these faculty members were done in the past. This is because the number of studies on STEM education is not very high when the departments are evaluated about that. However, this score shows that the score will rise in the future with instructors' enthusiasm experienced together with the students who are studying with them. The 2 points that the students give in this regard also indicate that they have similar judgments about the capacity of the teaching members. Although the faculty members are currently in an average position in this respect, there are phrases that they will be in better shape in the future.

If we look at the overall score of this domain, we see that it is above the average of with 2,5 point. Although average points of some departments like science education, chemistry education are under the average of the faculty, I can say that there is not significant difference between them. The indicator to be considered here is the STEM-centric culture. Because the faculty has a very good score on some of the other indicators as above average but 1,7 average score of that indicator in this respect is not enough. Moreover, 3 departments get 1 point on this indicator and that makes the situation worse. For this reason, they should try to do something in this matter and revise their plans as soon as possible so that they can provide an effective STEM education.

4.1.2.3 Scores of Domain III and IV

You can see the scores of domain III and IV from the table 14.

Table 14 Scores of Domain III and Domain IV

Departments	3.1 STEM Partnership	4.1 – 4.2 – 4.3 STEM Career Readiness
Faculty Deanery	2	2
Science Education	2	2
Mathematics Education	2	2
Educational Sciences	2	1
Physics Education	2	2
Chemistry Education	1	2
CEIT	1	1
Instructors Average	*1,7*	*1,7*
B.S. Student	1	1
M.Sc. Student	1	1
Students Average	*1*	*1*

The STEM Partnership indicator, which deals with the establishment of a strategic partnership for the development of STEM education, is scored low with 1.7 point average of faculty. In this regard, CEIT and chemistry education departments scores are 1, while the remaining departments and deanery score are 2. However, the students stated that there is no reflection of any partnership on them and were scored with 1 point. Students may be right in this regard. Because the departments that scored

2 in the interviews gave only the name of BILTEMM. But BILTEMM is not a center within the although it was established under the leadership of some of the faculty members in the faculty as mentioned in the previous sections. The number of projects carried out jointly with the faculty is also very low. In addition, there is almost no partnership of faculty apart from BILTEMMM. For this reason, the faculty needs to find an organization or organization that will be a strategic partnership of faculty in this regard as soon as possible.

Although many of the faculty members expressed a positive opinion on BILTEMM, there were some faculty members who are opposed to even open to this center. In addition, there were some differences between what faculty members said about the approach of the department/faculty to BILTEMM, and what faculty members at BILTEMM said about that issue.

In addition, although BILTEMM is a center established with the efforts of faculty members, it is not connected to faculty but is connected to the rectorate. BILTEMM faculty members say that this is because they prefer to be faced with the whole university, not just in faculties, in terms of interdisciplinary interaction. Moreover, although the faculty members report positive opinions about BILTEMM, it is stated that the faculty are not as enthusiastic as themselves and there were not enough joint projects.

The STEM career readiness score, which is the last domain, is not very high for the faculty. Like the previous scores, the average of the faculty is 1.7 while the average of the students is 1. This indicates that the faculty in not adequate enough at preparing students for a career in the STEM field. There has been no event in the faculty intended to talk about career opportunities in STEM to students until now. Only some members of the teaching staff have included this in small chats in their lessons and there was no information about the students about this situation. The number of projects related to STEM education carried out in the department is not very high now, but it should be noted that it is increasing. If the necessary attention is paid and the planned projects are put into practice, we can foresee that this number will come to an adequate level. Though there is no idea of opening a graduate or doctoral program in relation to STEM education, there is a suggestion to open an elective course package. This proposal has been positively approached and it is planned to do something like this in the future.

4.1.2.4 Summary of the Scores

After evaluating the scores of the different domains and indicators, we can look at the overall average of all scores in Table 15.

Table 15 Summary of the Scores

	Domain I	Domain II	Domain III	Domain IV	General Average
Deanery Score	2,8	3,1	2	2	2,5
Instructors Average	2,1	2,5	1,7	1,7	2
Student Average	1,4	2,4	1	1	1,5

According to the general score average, the readiness level of the faculty is 2.5 out of 4 according to the degree of proficiency, whereas this level is 1.5 according to the students and is 2 according to the instructors. It is a significant coincidence that the average of the instructors is equal to the exact average of deanery and student scores. Because these scores tell us that the faculty members are not as high as they reflect the dean, nor as low as they see the students. Or, in other words, they are at the exact equilibrium point that the dean reflects, and the students see. This situation is also important in terms of the validity of the study. Because the students are one point of faculty, the deanery at the status of faculty manager is the other point and the teaching members are in the middle of these two points.

We can specify the readiness level of the faculty as 2 out of 4 by taking the average of these three values. This value is not very low, but it is not at a sufficient level to provide effective STEM education, especially thinking the scores of students. For this reason, it should rise above 2 in the nearest time with applications of the plans described in the interview. An emerging readiness level may not be considered too low for STEM education, because it can still be considered as a new concept at the moment. But as the time progresses, the faculty will be old-fashioned unless they go beyond this value.

We can also interpret the readiness level of faculty with the dimensions required for an effective STEM education other than the emerging result of framework. There are five main dimensions of effective STEM education and these are STEM interest, 21^{st} century skills, technology and engineering, performance assessment and inquiry-based approaches (Clark, 2014; Next Generation Science Standards [NGSS], 2013; National Science Foundation, 2012; Yager, 2015). STEM interest has been associated with the use of real world problems and daily life examples in lessons. Bouillion and Gomez (2010) stated that the students' interests and motivations will increase as they feel they are beneficial to their own world and environment. Wells, Sanchez, & Attridge (2007) similarly stated that as teachers continue to stay away from the real world problems in their lessons, students will not be interested in their lesson and STEM career is not preferable for them. In addition to this, another way of enhancing the interest of students is to give them the opportunity to communicate and work with STEM members in their society (National Research Council [NRC], 2010). “STEM-centric Curriculum” and “STEM Career Readiness” indicators are associated with this domain and both scores are 1.7. By looking at these scores, we can say that the faculty is not very successful in the use of real world problems in lessons, or more general terms, to increase STEM interest.

21^{st} century skills can be narrowed down into collaboration, creativity, problem solving and critical thinking (Akgündüz, et al., 2015). According to DTI (2015), creativity, transformation of theoretical knowledge to practical knowledge, and manufacturing ability are important properties for an individual who have 21^{st} century skills. Besides, 21^{st} century skills are possible by inquiry according to Bybee (2010), NRC (2010) and Windschitl (2009). Inquiry can be also referred to as inquiry based approach, which is located between dimensions. I can state that the role of inquiry is very important based on many studies (Allen, Webb & Matthews, 2016; Bybee, 2010 & 2013; NGSS, 2013). In addition to the “Academic Rigor and Instructional Quality” indicator, which is directly related to these dimensions, the “STEM Program

Evaluation" and "STEM Partnerships" indicators can be viewed as indirectly relevant to these dimensions. The score of Academic Rigor and Instructional Quality indicator is 2.8 and this is sufficient but 2.0 score for STEM Program Evaluation and 1.7 score for STEM Partnerships is not enough for a sufficient level.

About the technology using, many researchers (Capraro, Capraro, Morhan, 2013; Guzey & Roehrig, 2009; Honey et al., 2014; ITEA, 2007) obtained that integration of hardware and software such as smartboards, sensors, etc. to the lessons, increases comprehensions of students. Moreover, Pamuk, Çakır, Ergun, Yılmaz and Ayas (2013) found that tablet usage in lessons increases the motivation of students. Beside technology, engineering is also very important concept for students (Dym, 1999). At that part, robotics and coding education obtained as beneficial in many studies. For example, reading, self-esteem and creativity skills can be gained with robotics according to Bergen (2001) and Erdogan, Corlu & Capraro (2013) found that literacy of students related to science, reading and mathematics increased as a result of robotics program. "STEM-centric culture" indicator is related to these dimensions and have a score of 2.0. At this point, I can say that the use of technology is at sufficient level based on the answers in the interviews but engineering applications and design are not preferable for instructors. Finally, performance assessment is important because students should be assessed by considering their performance during tasks or projects along with standardized tests to provide them 21st century skills (Bell, 2010; Ernst, 2008; Schunn, 2009; Windschitl, 2009). The assessment techniques used in the lessons were examined under the "Authentic Assessments" indicator and an extremely satisfactory score of 3.3 was obtained. Based on these scores and the answers given in the interviews, I can say that in almost all courses authentic assessment techniques are involved.

4.2 Expert Opinions

In this section, all transcripts and research memos that I kept is coded. At coding process, only significant statements were coded. Because statement to be coded should be significant enough to be meaningful for a study. Johnson & Christensen (2013) defined significant statement as a few sentences, a sentence, or a few words relating to the studying phenomenon particularly.

While significant statements were determined, their meanings were also described or determined and collected at a list. In the coding process, the records of the significant statements and their meanings are stored in a table so that they can be stored on a regular basis.

You can see the example of this table consisting of some significant statement and meanings from Table 16 at the next page.

Table 16 Sample Significant Statements and Meanings

Significant Statement	Meanings
STEM that enable students to use knowledge and produce something, is not a new approach. It began with an inquiry in 1969, and nowadays it is named STEM by adding engineering.	- How participants define STEM? - STEM perception of participant
STEM education has not a history or is not an established concept in Turkey.	- STEM education in Turkey
STEM is an American-originated approach. I know it started because of the decrease in number of students who have interest in science USA.	- STEM perception of participant - The role of US at STEM Education
Products of our students designed at the end of the lessons are lesson plans or posters etc., because they will use them in the future.	- Perception of designing a product or project-based learning
STEM is a political approach that giving importance most the economic benefits and is imposed on developing countries by the United States.	- Seeing STEM as political approach - The role of US at STEM Education
STEM is the progressivism of new age.	- STEM perception of participant
STEM is not a new term, it is an umbrella term created by including the engineering dimension.	- How participants define STEM? - STEM perception of participant
STEM is insufficient on its own, because it does not contain social dynamics. These need to be added as well.	- Seeing STEM as missing - Suggestion to STEM Education
Our job is to train teachers, not engineers.	- Mission of STEM in the idea of participant

Then the meaning parts were separated from transcript and categorized according to meanings. Each meaning is considered a category and significant statements are grouped under these categories. For example, STEM perceptions of participant, the role of US at STEM education, suggestion to STEM education or seeing STEM as political approach etc. were all one category.

Afterwards, similar ones among these categories began to be collected in the same group. For example, suggestion to STEM education and seeing STEM as missing meanings were combined and the number of categories decreased with these moves. As that process continues, the categories began to get narrower gradually becoming more general.

At this point, while the number of categories that initially consisted of meanings was more than 50, this number gradually decreased and eventually there were 5 categories under main headings. These 5 categories were the themes of my coding process and these are listed below.

- STEM is not a new term
- STEM is missing and insufficient
- STEM is an american imposition
- The needs to other faculties
- Resistance to STEM

There are also meaning units of these themes. Because the themes are made up of the most general expressions, the specific meanings within them are also in the meaning units. While theme is related to just one general idea, meaning units under it can be more than one. Themes of the study and meaning units of them presented at Table 17 at the next page.

Table 17 Themes and Meaning Units

Themes	Meaning Unit
STEM is not a new term	- STEM was existed, just engineering and design process is new - STEM was existed in the past as the use of interdisciplinary interaction and technology. - The work we did up to now was STEM - STEM is just a new acronym, we have been doing it for years.
STEM is missing and insufficient	- STEM definition not clear - Missing environmental dimension - Lack of sustainability dimension - Lack of social side - STEAM / STEAM-E
STEM is an american imposition	- We need to shape it based on the needs of Turkey - US plan to get quality work force from underdeveloped or developing countries - No need analysis for Turkish educational system - STEM is been working because of its popularity
The Needs to Other Faculties	- Needs to engineering faculties - Needs to industrial design faculties - Needs to arts and science faculties
Resistance	- STEM not looking forward is to go backward. - STEM emerged suddenly without any preparation or research and is supported by its popularity. - Instructors are not ready for STEM. - Engineering is unnecessary because it cannot be provided within the education faculty. - STEM, like multiple intelligence for a time, is a fuss now, but it will end in 2019 at the latest.

4.2.1 Themes

At the end of the coding process described above, 5 themes have appeared. Detailed explanations of these themes and related citations from participants' interviews are presented below.

4.2.1.1 STEM is Not a New Term

One of the theme of the study is seeing STEM not a new term. More than one participant stated that there is nothing new emerging about STEM in this regard. According to them, the education they have provided for many years is not much different from the STEM dynamics. The education they provided included science, mathematics, and technology from STEM's dimensions until now. Only the engineering has been added to these dimensions and they cannot give engineering education to students.

Beside these idea, some participants also considered STEM as just interdisciplinary approach. According to them, a multidisciplinary and interdisciplinary education is already STEM and this education has been given for many years at the department or faculty. There were also a few participants who thought that the use of technology and the student-based, student-seeking education were not much different from STEM. They said that they already gave the education in this way independently of STEM.

One of the participants said that they have been used STEM effectively for years in their department. Because STEM is actually just an acronym and there is basically no difference between STEM and project-based learning by doing design-based thinking in his/her idea. Below you can see the various quotations related to this issue from the participants of the study.

"STEM is nothing new. The student-centered approaches like inquiry teaching began in 1969, and today, they are confronted in different formats."

"STEM is just a new acronym, what is done is project-based learning and design-based thinking."

"I do not see STEM as something special, I see it as a collection of things that already exist under an umbrella. If we excluded the design dimension, we were already giving the education of other dimensions."

"The methods used our students at the course of teaching methods do not differ from STEM."

"We are not interested in the parts of the designs we have built, such as the aesthetic side, the usefulness of which is our lacking. Otherwise we do STEM."

"Our lessons are project-based and include all aspects of STEM, but we have been doing this for years, not because STEM has arrived."

4.2.1.2 STEM is Missing and Insufficient

During the interviews, almost all the instructors emphasize that the dimensions of STEM are missing and insufficient and indicate that some dynamics should be added to these dimensions. The most important dimension that they have emphasized is the lack of the social dimensions of STEM. According to them, economic concerns have come to the forefront because of STEM's engineering side. For this reason, social concerns have been laid down and even ignored. This is unacceptable for them.

In addition to the social dimension that many of them are wary of the lack of, the lack of environmental and sustainability is also pointed out by some teaching members and it is argued that STEM is useless in this way. While these proposals are being made, complaints have been made about the fact that STEM holds economic reasons in the forefront and this situation has been criticized.

In addition, a few instructors who have very positive views on STEM stated this incompleteness by saying that STEM's definition is still not clear. Instructors who say that confusion about the definition needs to be resolved first in order to demonstrate the necessary development in STEM should state that priority should be given to this. Here are some quotes from participants' answers during interviews on STEM's insufficiency.

"While integrating STEM to courses, it is necessary to talk about philosophy, sociology and social aspects. Students should be able to understand its ethic, philosophy, sociological consequences and their influence on individuals."

"STEM needs to be interpreted by processes that include cultural, global, social, political, individual, ethical, psychological, and all the other concerns."

"It must be STEAM, not STEM. Arts, liberal arts make a lot of difference, but engineering and design, robot part always comes to the forefront."

"Unfortunately, the definition of STEM is still unclear and everyone, including myself, has hesitations in this regard. These hesitations must be resolved as soon as possible."

"I find STEM very missing. Science, technology, engineering, and mathematics. Where is the environment dimension, sustainability dimension? I always ask that. It must be STEM-E, not STEM."

4.2.1.3 STEM is an American Imposition

Another theme that came to the forefront in the interviews was that STEM was the result of American imposition. STEM was already known to be based in the United States, but according to some instructors, United States did not only brought STEM to the literacy but tried to impose this concept to all over the world and Turkey is one these countries.

Because, according to their thinking, STEM is a concept that has emerged and started to be studied and applied in the direction of American needs of the country. The needs of our education system or education in the country are not the same as in the United States, so it is absurd to use and put into practice a concept shaped for their needs.

If STEM will be included in our education system, this should be done in line with the needs of our country and our education system. But all instructors who voiced this problem say that there is no needs analysis related to this issue at our country and is has been started to be implemented to our education system due to a political initiative. Here are some sentences related to this issue taken from the interviews of participants.

"STEM education is not an established concept in the past in Turkey, mostly new. We need to get away from the American point of view and realize our own objectives in line with our own needs."

"There is no point in trying to apply a concept, that the US has emerged and supported in line with the needs of their country, without organizing according to own dynamics."

"STEM is something that Americans have developed and imposed to underdeveloped countries for the aim of getting quality jobs from them."

"STEM was the result of American imposition and political reasons. We do not need this in the Turkish education system, and there is no need analysis in this regard."

4.2.1.4 The Needs to Other Faculties

In the interviews, some faculty members say that other faculties are needed to provide effective STEM education. Some faculty members emphasized the need for engineering faculty, especially for engineering and design processes. Because they think that the education faculty cannot provide the necessary engineering formation and that they do not have adequate equipment in this regard.

Some faculty members consider the mathematical and scientific dimensions and predict that students from one of these departments will not have enough knowledge about the other. For this deficiency, s/he thinks that faculties of science and arts are appropriate to close the shortage of mathematics students about science and the deficiencies of science students in mathematics.

In addition, there are some faculty members foresee that the education faculty alone will not be sufficient for the process of producing a product as solving of the real world problems that is frequently used in STEM education. Here are various quotes related to all these issues made from interviews of participants.

"A basic level of engineering skills course should be opened at the engineering faculty. We cannot give engineering education."

"Things about design are actually what industrial designers and engineers should think of, not us."

"Seeing STEM as a combination of four different components is problematic for mathematics education because math education students do not have enough knowledge in the science field."

"Faculty of arts and science should introduce a basic level course in which students outside the faculty departments can learn the basic concepts related to these departments."

"It is not something the education faculty can do alone, to give students real world problems and wait for a product to come out of them to solve these problems. Support from the engineering faculty is required."

4.2.1.5 Resistance

In the interviews, although it can be seen that positive views adopted about STEM education, there were some faculty members showing resistance to it. There are different reasons for seeing STEM unnecessary. The reason why STEM is so important as that it is becoming an increasing trend according to them. Some faculty members who claim that STEM emerges at some point without any preparatory stage, interpret STEM education as an unnecessary and backward move at the education system.

Some faculty members who share the suspicions about where the background of teaching members in the STEM topic are derived from, said that STEM is a fury and its popularity will end when it starts to decrease. Moreover, STEM education outside of engineering is done up to these years and engineering education cannot be given in education faculty in some faculty members' ideas. So, STEM is useless at this point according to them. You can see the related sentences of the participants at their interviews below.

"STEM education is unnecessary when there is a concept of sustainable resource usage in literature."

"STEM does not reflect the future, does not reflect the present, and does not reflect the reality."

"Since STEM is popular now, everyone is talking about it, supporting it. At the latest in 2019 this fury will end, and then there will be nothing as STEM."

"The only difference from STEM's existing teaching strategies is the engineering dimension. That dimension is not the responsibility of the education faculty, so STEM is an unnecessary concept."

CHAPTER 5

CONCLUSION

The purpose of this study was exploring the readiness level of a faculty of education in Turkey for providing effective STEM education in terms of the STEM Framework prepared by NYCDOE (2015) by considering the ideas of elements of this faculty. STEM education has emerged as an American-based concept continues to grow. Despite being out of the United States, it was not only within the borders of that country, but it was started to be of great importance both in Europe and in our country. Because with interdisciplinary learning that STEM education will provide students with, they will bring both critical and analytical thinking skills and learn to work in collaboration. In addition, a coding training that can be given in STEM education, as well as the ability of the student to think algorithmically will contribute greatly to its development.

In addition, a coding education that can be given in STEM education, will contribute greatly to its development by bringing students to the ability of the thinking algorithmically. In this way, qualified individuals educated in an effective STEM education process, will make their country one of the leading countries of the world in the future. Our country also decided to revise the education system in this context because they found an effective STEM education important. This is clearly stated in the report published by MoNE in 2016.

While the education system in the country is revising based on STEM education and it is integrating into curriculums, it is important that the education faculties provide this education effectively. Because the success of STEM education that is integrating into curriculum and even directly into our education system depends on teachers. Studies on the fact that one of the most important factors in the success, motivation and learning of the students is the teacher is in the literature (Rowan et al., 1997; Tytler & Osborn, 2012). Since the United States, which could be considered as the center of STEM education, is aware of this situation, it has begun to take steps to train teachers in this direction (Ashgar et al., 2012). Because of that, Turkey should start to question the competencies of teachers, so the education faculties that train them, on the STEM education.

In this context, it was decided to investigate the STEM readiness of the education faculty of one of the best universities in the country. For this purpose, the STEM Framework prepared by NYCDOE (2015) was transformed into a university level. Afterwards, interview questions were prepared based on this Framework and interviews were made with instructors from the departments in this education faculty. The findings obtained at the end of the analysis process are interesting.

Although the general attitude of the teaching staff on STEM education is positive, it shows that the attitude of the students is not so much, we can say that the situation is not very positive when we look at the themes obtained. Based on the themes, some faculty members do not see STEM education as a new term. According to them, the education they have been giving since years is already STEM, so it is not much needed. There were also a lot of faculty members who think that the definition of STEM is not clear, and that it is missing with the current disciplines. Afterwards, some instructors insisted that STEM is popular with the result of imposition of America and that it is not needed in our country. In addition, a few faculty members said that education faculties alone would not be able to provide STEM education and that other faculties are needed. Finally, it should be pointed out that there were teaching members who are obviously resistant to STEM. According to them, STEM is a fuss, a temporary and completely unnecessary acronym.

In addition to these themes, there are also scoring results based on the STEM Framework. According to these results, the general readiness level of faculty is 2 out of 4 according to instructors of the faculty. This score is 2,5 according to dean and 1,5 according to students. Based on these results, it can be said that the faculty is not in bad condition for STEM education. But even if the education faculty of one of the best universities in the country is at the emerging level about the readiness of STEM education, it is foreseen that this readiness level can be worse than emerging at other education of faculties.

Looking at the scores and the emerging themes of the faculty, we can say that the government should do something in education faculties related to STEM education before starting to integrate it into our education system. As mentioned in the interviews, a need analysis can be done in this regard before the integration process of STEM education begins. Likewise, since the needs of the US shaped STEM education, we can arrange and define it in the direction of our country's dynamics.

5.1 Suggestions for Further Studies

There may be a lot of suggestions that can be made from the findings of this study. First of all, new studies on STEM readiness concept can be done with this study. Because STEM education is so popular and there are many studies conducted but there is nearly no study related to STEM readiness in literature. In addition to this, the transformed version of STEM framework prepared by NYCDOE in this study can be used in further studies.

Moreover, the themes obtained in this study may also be inspiration for further studies. Each of these emerging themes or all of them can be examined together in another study to see how other faculties are in this situation. Similar studies can be repeated by expanding the sample. On this page, examinations can be made as to where the education faculties are ready for STEM education. A similar study can be done with pre-service teachers to investigate their STEM readiness.

STEM readiness level scale can be prepared based on the transformed version of framework and its identifiers in this study. Finally, the information shared in the study may also be useful for future studies. STEM readiness concept about which there were not much knowledge STEM education and its importance, and the other concepts and knowledge can be used at further studies.

5.2 Implications

Based on the results of the study and what is said in the interviews, the government needs to formulate an urgent action plan for STEM education. The main thing to do is to investigate whether the STEM education needs to be integrated into the existing education system. The impression taken from the interviews is that STEM education does not have an urgent need when other needs of the Turkish education system are considered. It should also be noted that there is a resistance to STEM education. There are faculty members who find STEM education inadequate and ones who see it as an American imposition or find it totally unnecessary. There is also no explicit information on how to integrate STEM education into the lectures.

In addition, the readiness level of the faculty of education studied in the study is also thought-provoking. In this study, in which the education given to the students is explored, the level of STEM integration achieved at the emerging level can not be considered as very bad. However, even if one of the country's best faculties is in this situation, it is impossible to think of positive things about the situation of other faculties about STEM education. STEM education has begun to be integrated into education system and its popularity is increasing day by day. However, there are not many studies about situation of faculties of education about this issue. On the basis of these results, it turns out that this mistake must be urgently resolved, and the importance of education faculties should be emphasized in this regard.

REFERENCES

Agar, M. The Professional Stranger. An Informal Introduction to Ethnography. 1980. *Academic Press, Orlando*.

Angen, M. J. (2000). Evaluating interpretive inquiry: Reviewing the validity debate and opening the dialogue. *Qualitative health research*, *10*(3), 378-395.

Akgündüz, D.; Ertepınar, H. (2015). *STEM eğitimi Türkiye raporu*. *Report*. https://doi.org/10.13140/RG.2.1.1980.0801

Akgündüz, D., Aydeniz, M., Çakmakçı, G., Çavaş, B., Özdemir, S., Çorlu, M. S., & Öner, T., Özdemir S. (2015). *STEM eğitimi Türkiye raporu: Günün modası mı yoksa gereksinim mi?* [A report on STEM Education in Turkey: A provisional agenda or a necessity?] [White Paper]. İstanbul, Turkey: Aydın Üniversitesi. Retrieved Nov 17, 2017.

Allen, M., Webb, A. W., & Matthews, C. E. (2016). Adaptive Teaching in STEM: Characteristics for Effectiveness. *Theory Into Practice*, *55*(3), 217-224.

Asghar, A., Ellington, R., Rice, E., Johnson, F., & Prime, G. M. (2012). Supporting STEM education in secondary science contexts. *Interdisciplinary Journal of Problem-Based Learning*, 6(2), 84-125.

Bandura, A. (1977). Self-efficacy: toward a unifying theory of behavioral change. *Psychological Review*, 84, 191-215.

Bandura, A. (1997). *Self-efficacy: The exercise of control*. New York: W.H. Freeman and Company.

Basham, J. D., & Marino, M. T. (2013). Understanding STEM education and supporting students through universal design for learning. *Teaching Exceptional Children*, *45*(4), 8-15.

Baskarada, S. (2014). Qualitative Case Study Guidelines. *The Qualitative Report*, 19(40), 1–25. https://doi.org/10.7748/nr2013.05.20.5.28.e327

Beekhuyzen, J., Nielsen, S. and von Hellens, L. (2010) The Nvivo Looking Glass: Seeing the Data Through the Analysis. In: *5th Conference on Qualitative Research in IT*, Brisbane: 29-30 Nov

Bell, S. (2010). Project-based learning for the 21st century: Skills for the future. *The Clearing House*, *83*(2), 39-43.

Bennett, A., & George, A. (1997, October). Research design tasks in case study methods. In *MacArthur Foundation Workshop on Case Study Methods, Belfer Center for Science and International Affairs (BCSIA), Harvard University* (pp. 17-19).

Berelson, B. 1954, Content Analysis, in G. Lindzey, (Ed.), *Handbook of Social Psychology*, Volume 1, Addison-Wesley, Reading MA

Bergen, D. (2001). Technology in the Classroom: Learning in the Robotic World: Active or Reactive?. *Childhood Education*, *77*(4), 249-250.

Bernard, H. R. 2000, *Social research methods: Qualitative and quantitative approaches*, SAGE, California and UK

Bertaux, D. (Ed.). (1981). *Bibliography and society: the life history approach in the social sciences*. London: Sage.

Boeije, H. (2002) A Purposeful Approach to the Constant Comparative Method in the Analysis of Qualitative Interviews. *Quality & Quantity* 36 391–409

Bouillion, L. M., & Gomez, L. M. (2001). Connecting school and community with science learning: Real world problems and school–community partnerships as contextual scaffolds. *Journal of research in science teaching*, *38*(8), 878-898.

Boyer, E. L. (1991). Ready to learn. *Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching*.

Breiner, J. M., Johnson, C. C., Harkness, S. S., & Koehler, C. M. (2012). What is STEM? A Discussion About Conceptions of STEM in Education and Partnerships. *School Science and Mathematics*, *112*, 3–11. https://doi.org/10.1111/j.1949-8594.2011.00109.x

Bybee, R. W. (2010). What Is STEM Education? *Science*, *329*(5995), 996–996. https://doi.org/10.1126/science.1194998

Bybee, R. W. 2013. *The case for STEM education: Challenges and opportunities*. Arlington: National Science Teachers Association (NSTA) Press.

Cakiroglu, J., Capa-Aydin, Y., & Hoy, A. W. (2012). Science teaching efficacy beliefs. In *Second international handbook of science education* (pp. 449-461). Springer Netherlands.

Capraro, R. M., Capraro, M. M., & Morgan, J. R. (Eds.). (2013). *STEM project-based learning: An integrated science, technology, engineering, and mathematics (STEM) approach*. Springer Science & Business Media.

Carmen F., Phil W., Anna C., Linda C. (2015). *STEM education framework*. New York: The New York City Department of Education. (2015). Retrieved from: http://schools.nyc.gov/NR/rdonlyres/DE2FC1DE-5FB8-474F-BD27D75FF70EF610/0/STEMframework_WEB1.pdf

Chen, X. (2014). STEM attrition: college students' paths into and out of STEM fields. In J. Valerio (Ed.), *Attrition in science, technology, engineering, and mathematics (STEM) education* (pp.1-96). NY: Nova Science Publishers.

Clark, J. V. (2014). Addressing the achievement gap in the United States. In *Closing the Achievement Gap from an International Perspective* (pp. 43-72). Springer, Dordrecht.

Colorado State University, 2006, *Conducting Content Analysis.* Retrieved from: http://writing.colostate.edu/guides/research/content/index.cfm

Copple, C. (1990). Ready To Learn: Early Childhood Education and the Public Schools.

Corlu, M. S., Capraro, R. M., & Capraro, M. M. (2014). Introducing STEM education: Implications for educating our teachers in the age of innovation. *Education and Science*, 39(171), 74-85.

Creswell, J. W. (2007). *Qualitative enquiry and research design: Choosing among five approaches.*

Creswell, J. W., & Clark, V. L. P. (2007). *Designing and conducting mixed methods research.* Thousand Oaks, CA:Sage.

Danish Technological Institute [DTI]. (2015). *Does EU need more STEM graduates? A final report*. Retrieved from: https://www.teknologisk.dk/_/media/64894_Does%20the%20EU%20need%20more%20STEM%20graduates.pdf

Davidson, F. (1996). *Principles of statistical data handling*. Sage Publications, Inc.

Denzin, N. K., & Lincoln, Y. S. (2005). *The Sage handbook of qualitative research.* Thousand Oaks, CA: Sage Publication, 695-728.

Dym, C. L. (1999). Learning engineering: Design, languages, and experiences. *Journal of Engineering Education*, *88*(2), 145-148.

Eisenhardt, K. M. (1989). Building theories from case study research. *Academy of management review*, *14*(4), 532-550.

Eisner, E. W. (1991). *The enlightened eye: Qualitative inquiry and the enhancement of educational practice*. New York: Macmillan.

Elkind, D. (2004). The problem with constructivism. *The Educational Forum*, 68(4), 306-312

Erdoğan, N. (2014). *Modeling successful inclusive STEM high schools: An analysis of students' college entry indicators in Texas*. (Doctoral dissertation). Texas A&M University, TX

Erdogan, N., Sencer Corlu, M., & Capraro, R. M. (2013). Defining innovation literacy: Do robotics programs help students develop innovation literacy skills?. *International Online Journal of Educational Sciences*, *5*(1).

Ernst, J. V. (2008). Analysis of cognitive and performance assessments in an Engineering/Technical Graphics Curriculum. *Analysis*, *45*(1).

General Accounting Office, 1996, *Content Analysis: A Methodology for Structuring and Analyzing Written Material. Report Nr. GAO/PEMD-10.3.1*. United States General Accounting Office, Washington. Retrieved from: http://archive.gao.gov/f0102/157490.pdf

Glaser, B. G. (2002) Constructivist Grounded Theory? *Forum: Qualitative Social Research* 3 (3)

Glaser, B. G. and Strauss, A. L. (1967) *The Discovery of Grounded Theory*. London, Weidenfeld and Nicolson

Graue, M. E. (1992). Social interpretations of readiness for kindergarten. *Early Childhood Research Quarterly*, 7(2), 225-243.

Green, M. (2007). *Science and engineering degrees: 1966-2004*. (NSF 07–307). Arlington, VA: National Science Foundation.

Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field methods, 18*(1), 59-82.

Guzey, S. S., & Roehrig, G. H. (2009). Teaching science with technology: case studies of science teachers' development of technological pedagogical content knowledge (TPCK). *Contemporary Issues in Technology and Teacher Education*, *9*(1), 25-45.

Günay, D., & Günay, A. (2016). Dünyada ve Türkiye'de Yükseköğretim Okullaşma Oranları ve Gelişmeler. *Journal of Higher Education & Science/Yüksekögretim ve Bilim Dergisi*, *6*(1).

Franzosi, R. 2004, Content analysis, in Lewis-Beck, M, Bryman, A and Liao, T F (Ed), *The SAGE Encyclopaedia of Social Science Research Methods*, SAGE, California and UK

Freberg, L. (1991). Relationships between chronological age, developmental age, and standardized achievement tests in kindergarten. *Psychology in the Schools*, *28*(1), 77-81.

Hansson, B. (2008). OECD *Measures on Human Capital and Potential Use in Educational Accounts.* Workshop on the Measurement of Human Capital.

Hersey, P. & Blanchard, K. H. (1988). *Management of organizational behavior*. (5th Ed.), pp.169-201. Englewood Cliffs, NJ: Prentice Hall.

Honey, M. Pearson, G., & Schweingruber, H. (2014). *STEM integration in K-12 education: Status, prospects, and an agenda for research*. National Academy of Engineering [NAE] and National Research Council [NRC]. Washington, DC: The National Academies Press.

Howe, A. C. & Stubbs, H. S. (2003). From science teacher to teacher leader: Leadership development as meaning making in a community of practice. *Science Education*, 87(2), 280.

Horizon 2020. (2015). *The EU framework programme for research and innovation*. Retrieved from: http://ec.europa.eu/programmes/horizon2020/en

Inan, F. A. & Lowther, D. L. (2010). Laptops in the k-12 classrooms: exploring factors impacting instructional use. *Computers & Education*, 55, 937–944

Ilg, F., & Ames, L. B. (1972). *School readiness.* New York: Harper & Row.

International Technology Education Association. 2007. *Standards for technological literacy: Content for the study of technology*. 3rd ed. Reston, VA: ITEEA.

Jensen, J. L., & Rodgers, R. (2001). Cumulating the intellectual gold of case study research. *Public Administration Review*, *61*(2), 235-246.

Johnson, R. B., & Christensen, L. (2013). *Educational Research: Quantitative, Qualitative, and Mixed Approaches*. SAGE Publications. Retrieved from https://books.google.com.tr/books?id=jUMXBAAAQBAJ

Junginger, J. (1996). Psychosis and violence: the case for a content analysis of psychotic experience. *Schizophrenia bulletin*, *22*(1), 91-103.

Kalpan, A. 1943, Content analysis and the theory of signs, *Philosophy of Science*, 10, pp230-247

Katehi L., Pearson, G., & Feder, M. (Eds.) (2009). *Engineering in K-12 education: Understanding the status and improving the prospects.* Report from the Committee on K-12 Education for the National Academies. Washington DC: The National Academies Press.

Kayseri MEM. (2015). Kayseri Milli Eğitim Müdürlüğü STEM. Retrieved from: http://kayseri.meb.gov.tr/stem

Kisker, E. E. (1992). School readiness: The contribution of formal early education and care programs. *Princeton, NJ: Mathematica Policy Research. (ERIC Document Reproduction Service No. ED 350 083).*

Krippendorff, K. 2004, *Content Analysis: an introduction to its methodology*. 2nd edition, SAGE, California and London

Kulatunga, U., Haigh, A., Amaratunga, D., & Haigh, R. (2007). Structuring the unstructured data: the use of content analysis Title Structuring the unstructured data: the use of content analysis STRUCTURING THE UNSTRUCTURED DATA: THE USE OF CONTENT ANALYSIS. *7th International Postgraduate Conference in the Built and Human Environment.* Retrieved from http://usir.salford.ac.uk/9857/

Kvale, S. (2006). Dominance through interviews and dialogues. *Qualitative inquiry*, *12*(3), 480-500.

Labov, J. B., Reid, A. H., & Yamamoto, K. R. (2010). Integrated biology and undergraduate science education: a new biology education for the twenty-first century? *CBE Life Science Education*, *9*, 10–16.

Lather, P., & Lather, P. A. (1991). *Getting smart: Feminist research and pedagogy with/in the postmodern*. Psychology Press.

Lather, P. (1993). Fertile obsession: Validity after poststructuralism. *The sociological quarterly*, *34*(4), 673-693.

LeCompte, M. D., & Goetz, J. P. (1982). Problems of reliability and validity in ethnographic research. *Review of educational research*, *52*(1), 31-60.

Leech, N. L. and Onwuegbuzie, A. J. (2011) Beyond Constant Comparison Qualitative Data Analysis: Using NVivo. *School Psychology Quarterly* 26 (1) 70–84

Lincoln, Y. S., & Guba, E. G. (1985). *Naturalistic inquiry* (Vol. 75). Sage.

Lipson, J. G. (1994). Ethical issues in ethnography. *Critical issues in qualitative research methods*, 333-355. Thousand Oaks, CA: Sage.

Mason, M. (2010, August). Sample size and saturation in PhD studies using qualitative interviews. In *Forum qualitative Sozialforschung/Forum: qualitative social research* (Vol. 11, No. 3).

Mayring, P. 2000, Qualitative Content Analysis, *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, 1.2. Retrieved from: http://www.qualitative-research.net/fqs-texte/2-00/2-00mayring-e.htm

Mehta, Arun C (2004), *"Indicators of Educational Development with focus on Elementary Education: Concept and Definitions"*, NIEPA, New Delhi.

Merriam, S. B. (1998). *Qualitative Research and Case Study Applications in Education. Revised and Expanded from" Case Study Research in Education."*. Jossey-Bass Publishers, 350 Sansome St, San Francisco, CA 94104.

Miles, M. B., & Huberman, A. M. (1994). Qualitative case analysis: A sourcebook of new methods. *Sage Publications, Inc, Thousand Oaks, CA.*

Milli Eğitim Bakanlığı Ortaöğretim Genel Müdürlüğü. (2016). 2016 *İzleme ve değerlendirme raporu*. Ankara.

Morse, J. M. (1995). *The significance of saturation*. Qualitative Health Research (5:2), 1st May, pp 147–149.

Morse, J. M. & Richards, L. (2002) *Readme first for a user's guide to qualitative* methods. London, Sage Publications

Nair, G. S., & Riege, A. M. (1995, July). Using convergent interviewing to develop the research problem of a postgraduate thesis. In *Proceedings, Marketing Educators and Researchers International Conference, Griffith University, Gold Coast*.

National Academy of Engineering [NAE] (2009). *Engineering in K–12 education: Understanding the status and improving the prospects*. Washington, DC: National Academies Press.

National Economic Council, Council of Economic Advisers, & Office of Science and Technology Policy. (February, 2011). *A strategy for American innovation: Securing our economic growth and prosperity*. Retrieved from: http://www.whitehouse.gov/innovation/strategy

National Education Goals Panel. (1993). *The National Goals Report.* Washington, DC: US Government Printing Office.

National Research Council. (2011). *Learning science through computer games and simulations*. National Academies Press.

National Science Board. (February, 2015). *Revisiting the STEM workforce*.

National Science Foundation. (2012). *Science and engineering indicators* 2012. Washington, D.C.: The National Science Foundation.

NGSS Lead States. (2013). *Next generation science standards: for states, by states*. Washington, DC: The National Academies Press.

Nunkoosing, K. (2005). The problems with interviews. *Qualitative health research*, *15*(5), 698-706.

OECD. (2016). *PISA 2015 results in focus.*

Oner, A. T., Navruz, B., Biçer, A., Peterson, C. A., Capraro, R. M., & Capraro, M. M. (2014). T-STEM academies' academic performance examination by education service centers: A longitudinal study. *Turkish Journal of Education*, *3*(4), 40-51.

ÖSYM. (2017). *Merkezi Yerleştirme İle Öğrenci Alan Yükseköğretim Lisans Programları.* Ankara: ÖSYM. Retrieved from: http://www.osym.gov.tr/TR,13312/2017-osys-yerlestirme-sonuclarina-iliskin-sayisal-bilgiler.html

Pamuk, S., Çakır, C., Ergun, M, Yılmaz, H. B. & Ayas, C. (2013). Öğretmen ve öğrenci bakış açısıyla tablet pc ve etkileşimli tahta kullanımı: Fatih projesi değerlendirmesi. *Kuram ve Uygulamada Egitim Bilimleri*, 13(3), 1815-1822.

Partnership for 21st Century Learning. (2015). *Framework for 21st Century Learning*, 2. Retrieved from: http://www.p21.org/storage/documents/docs/P21_Framework_Definitions_New_Logo_2015.pdf

Patton, M. Q. (2002). Designing qualitative studies. *Qualitative research and evaluation methods*, *3*, 230-246.

Perakyla, A. (1997). Reliability and validity in research based on tapes and transcripts. *Qualitative research: Theory, method and practice, 201220*.

Piaget, J., & Piers, M. W. (1972). *Play and development*. WW Norton.

Philips, R. (2013). *A comparison of college readiness among students enrolled in Texas science, technology, engineering, and mathematics academies and traditional comprehensive high schools.* (Doctoral dissertation). ProQuest Dissertations and Theses database (UMI No. 3567905)

Plummer, K. (1983). *Documents of life: An introduction to the problems and literature of a humanistic method.* Allen & Unwin.

President's Council of Advisors on Science and Technology [PCAST]. (2010). *Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future*. Retrieved from: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemedreport.pdf

President's Council of Advisors on Science and Technology [PCAST]. 2012. Report to the President. Engage to excel: *Producing one million additional college graduates with degrees in science, technology, engineering and mathematics.* Retrieved from: http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-engage-to-excel-final_2-25-12.pdf

Rocard, M., Csermely, P., Jorde, D., Lenzen, D., Walberg-Henriksson, H., & Hemmo, V. (2007). Science Education NOW: A renewed pedagogy for the future of Europe, Brussels: European Commission. *Luettu.* Retrieved from*: http://ec.europa.eu/research/science-society/document_library/pdf_06/report-rocard-onscience-education_en.pdf*

Rowan, B., Chiang, F. S., & Miller, R. J. (1997). Using research on employees' performance to study the effects of teachers on students' achievement. *Sociology of Education*, 256-284.

Sanders, M. (2009). STEM, STEM education, STEM mania. *Technology Teacher, 68*(4), 20–26.

Schunn, C. (2009). Are 21st century skills found in science standards? Paper prepared for the Workshop on Exploring the Intersection of Science Education and the Development of 21st Century Skills, National Research Council.

Silverman, D. (2005). Doing qualitative research. 2. painos. *Iso-Britannia: The Cromwell Press Lrd*.

Simon, H. (1969). *Sciences of the artificial*. Cambridge, MA: MIT Press.

Stake, R. E. (1995). *The art of case study research*. Thousand Oaks, CA: Sage.

Stake, R. E. (2005). Qualitative case studies. In N. K. Denzin & Y. S. Lincoln (Eds.), *The Sage handbook of qualitative research* (3rd ed., pp. 443-466). Thousands Oaks, CA: Sage.

Steele, A., Brew, C., Rees, C. & Ibrahim-Khan, S. (2013). Our practice, their readiness: teacher educators collaborate to explore and improve preservice teacher readiness for science and math instruction. *Journal of Science Teacher Education*, 24(1), 111-131.

STEM Okulu. (2015). STEM for disadvantaged students especially girls. Retrieved from: http://www.stemokulu.com.

Stemler, S. 2001, An overview of content analysis, *Practical Assessment. Research & Evaluation*, 7.17

Sting. (2014). *STEM Teacher training innovation for Gender balance, an ERASMUS+ project*. Retrieved from: www.stingeuproject.wordpress.com

Swan, J. 1997, Using cognitive mapping in management research: Decisions about technical innovations, *British Journal of Management*, 8, pp183-198

Şatgeldi, A. N. (2017). *Development of an Instrument for Science Teachers' Perceived Rediness in STEM Education* (Unpublished master thesis). Ankara: Middle East Technical University.

Teaching Institute for Excellence in STEM. (2010). What is STEM Education? Retrieved from: http://www.tiesteach.org/stem-education.aspx

Teichler, U. (2004). *Changing Structures of Higher Education Systems: The Increasing Complexity of Underliying Forces. Centre for Research on Higher Education and Work.* Kassel: University of Kassel. Retrieved from: http://unesdoc.unesco. org/images/0014/001467/146736e.pdf

TEDMEM. (2016). *2016 Eğitim Değerlendirme Raporu.* Ankara: Türk Eğitim Derneği Yayınları.

TÜBİTAK. (2015). *Türkiye bilimsel ve teknolojik araştirma kurumu: Destekler*. Retrieved from: http://www.tubitak.gov.tr/tr/destekler/akademik/ulusal-destek-programlari

Türkiye İstatistik Kurumu. (n.d.). *Eğitim istatistikleri* Retrieved from: http://www.tuik.gov.tr/UstMenu.do?metod=temelist

TÜSİAD. (2014). *STEM alanında eğitim almış işgücüne yönelik talep ve beklentiler araştırması.* Retrieved from: http://www.tusiad.org.tr/__rsc/shared/file/STEM-ipsos-rapor.pdf

Tytler, R. & Osborne, J. (2012). Student attitudes and aspirations towards science. In B. J. Fraser & K. G. Tobin (Eds.), *Second International Handbook of Science Education* (pp.597-626). NY: Springer.

US Bureau of Labor Statistics. (2015). *Labor force characteristics by race and ethnicity, 2014*(Report No.1057). Retrieved from: https://www.bls.gov/opub/reports/race-and-ethnicity/archive/labor-forcecharacteristics-by-race-and-ethnicity-2014.pdf

Weis, L., & Fine, M. (2000). *Speed Bumps: A Student-Friendly Guide to Qualitative Research.* Teachers College Press, PO Box 20, Williston, VT 05495-0020.

Wells, B. H., Sanchez, H. A., & Attridge, J. M. (2007, November). Modeling student interest in science, technology, engineering and mathematics. In *Meeting the Growing Demand for Engineers and Their Educators 2010-2020 International Summit, 2007 IEEE* (Vol. 50, pp. 1-17). IEEE.

White House. (2015). *USA Research & Development budgets*. Retrieved from: http://www.whitehouse.gov/administration/eop/ostp/rdbudgets

Whittemore, R., Chase, S. K., & Mandle, C. L. (2001). Validity in qualitative research. *Qualitative health research*, *11*(4), 522-537.

Windschitl, M. (2009). *Cultivating 21st century skills in science learners: how systems of teacher preparation and professional development will have to evolve.* Presentation given at the National Academies of Science Workshop on 21st Century Skills, Washington, DC.

Wolcott, H. F. (1994). *Transforming qualitative data: Description, analysis, and interpretation*. Sage.

Yager, R. E., & Brunkhorst, H. (2014). *Exemplary STEM programs: Designs for success*. NSTA Press.

Yin, R. K. (2003). Case study research: design and methods, Applied social research methods series. *Thousand Oaks, CA: Sage Publications, Inc. Afacan, Y., & Erbug, C.(2009). An interdisciplinary heuristic evaluation method for universal building design. Journal of Applied Ergonomics*, *40*, 731-744.

Zhang, T., and Kuo, J. 2001, Audio Content Analysis for Online Audiovisual Data Segmentation and Classification, *IEEE Transactions on Speech and Audio Processing,* 9.4

APPENDIX A

HUMAN SUBJECTS ETHICS COMMITTEE APPROVAL FORM

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

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07 HAZİRAN 2017

Konu: Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi: İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Prof. Dr. Ömer GEBAN ;

Danışmanlığını yaptığınız yüksek lisans öğrencisi Selçuk KILINÇ'ın ***"Eğitim Fakültelerinin STEM Eğitimine Hazır Olma Durumlarının Belirlenmesi"*** başlıklı araştırması İnsan Araştırmaları Etik Kurulu tarafından uygun görülerek gerekli onay **2017-EGT-124** protokol numarası ile **03.07.2017 – 31.12.2017** tarihleri arasında geçerli olmak üzere verilmiştir.

Bilgilerinize saygılarımla sunarım.

Prof. Dr. Ş. Halil TURAN
Başkan V

Prof. Dr. Ayhan SOL
Üye

Prof. Dr. Ayhan Gürbüz DEMİR
Üye

Doç. Dr. Yaşar KONDAKÇI
Üye

Doç. Dr. Zana ÇITAK
Üye

BULUNAMADI
Yrd. Doç. Dr. Pınar KAYGAN
Üye

Yrd. Doç. Dr. Emre SELÇUK
Üye

APPENDIX B

INTERVIEW QUESTIONS

A - Interview Questions of Professors / Assistant Professors (Instructors)

Domain I – School Vision and Structure for Success

1.1 STEM Mission and Vision

Daha önce STEM'i duymuş muydunuz? Ne olduğunu biliyor musunuz?
STEM eğitimi verilmesi hakkındaki düşünceleriniz neler?
Öğretim üyeleri STEM eğitimini önemli buluyorlar mı?

Bölüm vizyon ve misyonları arasında STEM eğitimi yer alıyor mu?
Herhangi bir dökümanda geçiyor mu? Vizyon belgelerinde belirtildi mi?
Bu vizyonu bölümün tamamı paylaşıyor mu?
Ortak bir toplantıda konuştunuz mu? Bölümün bu konudaki genel tutumu nedir?

1.2 STEM-centric Culture

Bölümün atmosferi STEM eğitimine uygun mu? Bölümdeki öğretim üyelerinin STEM eğitimine bakış açısı ne yöndedir?

Bölümdeki dersler inter ya da trans disipliner şekilde mi işleniyor?
Öğretim üyeleri, bölüm içindeki diğer öğretim üyeleri ile ve diğer bölümlerdeki öğretim üyeleri ile bilgi alışverişinde bulunuyorlar mı?

Bölümdeki derslerin içeriğinde STEM'in dört farklı alanından (Bilim, Teknoloji, Mühendislik, Matematik) hangilerine değiniliyor?
Proje tabanlı eğitim ya da mühendislik uygulamaları derslerinizde yer alıyor mu?
Derslerinize teknoloji entegrasyonu yapılıyor mu?
Bölümde STEM eğitimine uygun şekilde dizayn edilmiş sınıflar ya da laboratuvarlar bulunuyor mu?

1.3 STEM Program Evaluation

Bölümüzün programının hazırlanması sürecince STEM eğitimi baz alındı mı? Siz bu bağlamda bölüm programlarını inceliyor musunuz?

Bölüm toplantılarında bu konuyu gündeminize alıyor musunuz? Yapılması düşünülen şeyler var mı?

1.4 Budget/Management of Resources

Bölüm bütçesinde STEM eğitimi üzerine ayrılan bir bütçe var mı?
Yoksa ➔ Bunun üzerine bir şey yapılması düşünülüyor mu?
Varsa ➔ Bu bütçe yeterli mi? Arttırmayı düşünür müsünüz?

Domain II – STEM Curriculum, Instruction, and Assessment

2.1 Academic Rigor and Instructional Quality

Bölümünüzde verilen eğitim öğrenci merkezli şekilde mi veriliyor?
Öğrenci öğrenme sürecinin içinde aktif bir şekilde rol alabiliyor mu?
Öğrencilere verilen dersler bölümünüzün (varsa) STEM misyon ve vizyonuyla ne derece örtüşüyor?

2.2 STEM-centric Curriculum

Bölümünüzdeki derslerinizin işlenişinin, STEM eğitimiyle ne derece örtüştüğünü düşünüyorsunuz? Bu derslerde öğrencilere günlük hayattan problemler vererek, onlardan bu problemlere STEM sentezine uygun bir şekilde bilimsel altyapılarını kullanıp, sürece teknolojiyi de entegre edecek şekilde çözüm üretmesini isteniyor mu?

Verilen ders içeriklerine baktığımızda salt STEM eğitimi üzerine verilen bir ders var mı?
Derslerin dışında STEM, STEM eğitimi ve benzer içeriklerde aktiviteler bölümünüzde düzenleniyor mu?
Varsa ➔ Bu dersler/aktiviteler neler? Öğrencilerin bunlara yaklaşımları ne şekilde oluyor?
Yoksa ➔ Bu içerikte bir ders açılmasını, bu tarzda aktiviteler düzenlenmesini düşünüyor musunuz?

2.3 Authentic Assessment

Bölümüzde verilen derslerde ölçme/değerlendirme hangi yolla yapılıyor?
Projeler, portfolyolar, sözlü sunumlar gibi otantik yollar kullanılıyor mu?

2.4 Staff Capacity

Bölümünüz bünyesindeki öğretim üyelerinin STEM konusundaki kapasitelerini nasıl değerlendirirsiniz?
STEM konusunda çalışma yapan bölümünüz bünyesinde öğretim üyeleriniz var mı?
Öğrencilerden biri STEM alanında çalışma yapmak isterse, bu konuda birlikte çalışabileceği öğretim üyesi/üyeleri var mı?

Domain III – Strategic Partnership

3.1 STEM Partnership

STEM eğitiminin geliştirilmesi amacıyla stratejik bir ortaklık yürüttüğünüz bir kuruluş, bakanlık, iş yeri, topluluk veya başka bir üniversite var mı?
BILTEMM derlerse ➔ BILTEMM fakülte bünyesinde bir merkez mi? Fakülteye entegre bir kuruluş var mı?
Bölümünüz BILTEMM ile mi çalışıyor mu? Bölümünüzdeki hocalar BILTEMM ile çalışıyor mu?
BILTEMM ile orta yürüttüğünüz bir proje var mı? Onlara ne derece destek oluyorsunuz?
BILTEMM bir çalışma yapmak isterse onlara bölümünüzü açar mısınız?

Domain IV – STEM College and Career Readiness

4.1 STEM Path Preparation for Elementary School

4.2 Access to STEM college and career oppotunities for middle and high school students

4.3 Planning Student Outreach and Support for Pre-K-12 STEM Initiatives

Öğrencilere STEM alanındaki kariyer fırsatlarından bahsetmek amacıyla bilgilendirme, sunum ya da farklı etkinlikler yapılıyor mu?
Bölümünüzde yüksek lisans ve doktora öğrencilerini çekebilmek amaçlı onların da yer alabileceği STEM alanında çalışmalar, projeler yürütülüyor mu?
Okullara STEM lideri yetiştirmek ya da STEM alanında yetkin sayılabilmek amaçlı bu yönde spesifik bir yüksek lisans ya da doktora programı var mı? Ya da düşünülüyor mu?

B - Interview Questions of Faculty Dean

Domain I – School Vision and Structure for Success

1.1 STEM Mission and Vision

Daha önce STEM'i duymuş muydunuz? Ne olduğunu biliyor musunuz?
STEM eğitimi verilmesi hakkındaki düşünceleriniz neler?
Fakülte yöneticileri STEM eğitimini önemli buluyorlar mı?

Fakülte vizyon ve misyonları arasında STEM eğitimi yer alıyor mu?
Herhangi bir dökümanda geçiyor mu? Vizyon belgelerinde belirtildi mi?
Bu vizyonu fakültenin tamamı paylaşıyor mu?
Ortak bir toplantıda konuştunuz mu? Fakültenin bu konudaki genel tutumu nedir?

1.2 STEM-centric Culture

Fakültenin atmosferi STEM eğitimine uygun mu? Bölümdeki öğretim üyelerinin STEM eğitimine bakış açısı ne yöndedir?

Fakültenizdeki dersler inter ya da trans disipliner şekilde mi işleniyor?
Fakültedeki öğretim üyeleri, bölüm içindeki diğer öğretim üyeleri ile ve diğer bölümlerdeki öğretim üyeleri ile bilgi alışverişinde bulunuyorlar mı?

Fakültedeki derslerin içeriğinde STEM'in dört farklı alanından (Bilim, Teknoloji, Mühendislik, Matematik) hangilerine değiniliyor?
Proje tabanlı eğitim ya da mühendislik uygulamaları derslerde yer alıyor mu?
Derslerinize teknoloji entegrasyonu yapılıyor mu?
Fakültede STEM eğitimine uygun şekilde dizayn edilmiş sınıflar ya da laboratuvarlar bulunuyor mu?

1.3 STEM Program Evaluation

Fakültedeki bölümlerin programının hazırlanması sürecince STEM eğitimi baz alındı mı? Siz bu bağlamda bölüm programlarını inceliyor musunuz?

Fakülte toplantılarında bu konuyu gündeminize alıyor musunuz? Yapılması düşünülen şeyler var mı?

1.4 Budget/Management of Resources

Fakülte bütçesinde STEM eğitimi üzerine ayrılan bir bütçe var mı?
Yoksa ➔ Bunun üzerine bir şey yapılması düşünülüyor mu?
Varsa ➔ Bu bütçe yeterli mi? Arttırmayı düşünür müsünüz?

Domain II – STEM Curriculum, Instruction, and Assessment

2.1 Academic Rigor and Instructional Quality

Fakültenizde verilen eğitim öğrenci merkezli şekilde mi veriliyor?
Öğrenci öğrenme sürecinin içinde aktif bir şekilde rol alabiliyor mu?
Öğrencilere verilen dersler fakültenizin (varsa) STEM misyon ve vizyonuyla ne derece örtüşüyor?

2.2 STEM-centric Curriculum

Fakültenizdeki derslerinizin işlenişinin, STEM eğitimiyle ne derece örtüştüğünü düşünüyorsunuz? Bu derslerde öğrencilere günlük hayattan problemler vererek, onlardan bu problemlere STEM sentezine uygun bir şekilde bilimsel altyapılarını kullanıp, sürece teknolojiyi de entegre edecek şekilde çözüm üretmesini isteniyor mu?

Verilen ders içeriklerine baktığımızda salt STEM eğitimi üzerine verilen bir ders var mı?
Derslerin dışında STEM, STEM eğitimi ve benzer içeriklerde aktiviteler fakültenizde düzenleniyor mu?
Varsa ➔ Bu dersler/aktiviteler neler? Öğrencilerin bunlara yaklaşımları ne şekilde oluyor?
Yoksa ➔ Bu içerikte bir ders açılmasını, bu tarzda aktiviteler düzenlenmesini düşünüyor musunuz?

2.3 Authentic Assessment

Fakültenizde verilen derslerde ölçme/değerlendirme hangi yolla yapılıyor?
Projeler, portfolyolar, sözlü sunumlar gibi otantik yollar kullanılıyor mu?

2.4 Staff Capacity

Fakülteniz bünyesindeki öğretim üyelerinin STEM konusundaki kapasitelerini nasıl değerlendirirsiniz?
STEM konusunda çalışma yapan fakülteniz bünyesinde öğretim üyeleriniz var mı?
Öğrencilerden biri STEM alanında çalışma yapmak isterse, bu konuda birlikte çalışabileceği öğretim üyesi/üyeleri var mı?

Domain III – Strategic Partnership

3.1 STEM Partnership

STEM eğitiminin geliştirilmesi amacıyla stratejik bir ortaklık yürüttüğünüz bir kuruluş, bakanlık, iş yeri, topluluk veya başka bir üniversite var mı?
BILTEMM derlerse ➔ BILTEMM fakülte bünyesinde bir merkez mi? Fakülteye entegre bir kuruluş var mı?
Fakülte BILTEMM ile mi çalışıyor mu? Fakültedeki hocalar BILTEMM ile çalışıyor mu?
BILTEMM ile orta yürüttüğünüz bir proje var mı? Onlara ne derece destek oluyorsunuz?
BILTEMM bir çalışma yapmak isterse onlara fakültenizi açar mısınız?

Domain IV – STEM College and Career Readiness

4.1 STEM Path Preparation for Elementary School

4.2 Access to STEM college and career oppotunities for middle and high school students

4.3 Planning Student Outreach and Support for Pre-K-12 STEM Initiatives

Öğrencilere STEM alanındaki kariyer fırsatlarından bahsetmek amacıyla fakültenizde bilgilendirme, sunum ya da farklı etkinlikler yapılıyor mu?
Fakültede yüksek lisans ve doktora öğrencilerini çekebilmek amaçlı onların da yer alabileceği STEM alanında çalışmalar, projeler yürütülüyor mu?
Okullara STEM lideri yetiştirmek ya da STEM alanında yetkin sayılabilmek amaçlı bu yönde spesifik bir yüksek lisans ya da doktora programı var mı? Ya da düşünülüyor mu?

C - Interview Questions of Head of BILTEMM

Domain I – School Vision and Structure for Success

1.1 STEM Mission and Vision

Daha önce STEM'i duymuş muydunuz? Ne olduğunu biliyor musunuz?
STEM eğitimi verilmesi hakkındaki düşünceleriniz neler?
Öğretim üyeleri STEM eğitimini önemli buluyorlar mı?

Bölüm vizyon ve misyonları arasında STEM eğitimi yer alıyor mu?
Herhangi bir dökümanda geçiyor mu? Vizyon belgelerinde belirtildi mi?
Bu vizyonu bölümün tamamı paylaşıyor mu?
Ortak bir toplantıda konuştunuz mu? Bölümün bu konudaki genel tutumu nedir?

1.2 STEM-centric Culture

Bölümün atmosferi STEM eğitimine uygun mu? Bölümdeki öğretim üyelerinin STEM eğitimine bakış açısı ne yöndedir?

Bölümdeki dersler inter ya da trans disipliner şekilde mi işleniyor?
Öğretim üyeleri, bölüm içindeki diğer öğretim üyeleri ile ve diğer bölümlerdeki öğretim üyeleri ile bilgi alışverişinde bulunuyorlar mı?

Bölümdeki derslerin içeriğinde STEM'in dört farklı alanından (Bilim, Teknoloji, Mühendislik, Matematik) hangilerine değiniliyor?
Proje tabanlı eğitim ya da mühendislik uygulamaları derslerinizde yer alıyor mu?
Derslerinize teknoloji entegrasyonu yapılıyor mu?
Bölümde STEM eğitimine uygun şekilde dizayn edilmiş sınıflar ya da laboratuvarlar bulunuyor mu?

1.3 STEM Program Evaluation

Bölümüzün programının hazırlanması sürecince STEM eğitimi baz alındı mı?
Siz bu bağlamda bölüm programlarını inceliyor musunuz?

Bölüm toplantılarında bu konuyu gündeminize alıyor musunuz? Yapılması düşünülen şeyler var mı?

1.4 Budget/Management of Resources

Bölüm bütçesinde STEM eğitimi üzerine ayrılan bir bütçe var mı?
Yoksa ➔ Bunun üzerine bir şey yapılması düşünülüyor mu?
Varsa ➔ Bu bütçe yeterli mi? Arttırmayı düşünür müsünüz?

Domain II – STEM Curriculum, Instruction, and Assessment

2.1 Academic Rigor and Instructional Quality

Bölümünüzde verilen eğitim öğrenci merkezli şekilde mi veriliyor?
Öğrenci öğrenme sürecinin içinde aktif bir şekilde rol alabiliyor mu?
Öğrencilere verilen dersler bölümünüzün (varsa) STEM misyon ve vizyonuyla ne derece örtüşüyor?

2.2 STEM-centric Curriculum

Fakültenizdeki derslerinizin işlenişinin, STEM eğitimiyle ne derece örtüştüğünü düşünüyorsunuz? Bu derslerde öğrencilere günlük hayattan problemler vererek, onlardan bu problemlere STEM sentezine uygun bir şekilde bilimsel altyapılarını kullanıp, sürece teknolojiyi de entegre edecek şekilde çözüm üretmesini isteniyor mu?

Verilen ders içeriklerine baktığımızda salt STEM eğitimi üzerine verilen bir ders var mı?
Derslerin dışında STEM, STEM eğitimi ve benzer içeriklerde aktiviteler bölümünüzde düzenleniyor mu?
Varsa ➔ Bu dersler/aktiviteler neler? Öğrencilerin bunlara yaklaşımları ne şekilde oluyor?
Yoksa ➔ Bu içerikte bir ders açılmasını, bu tarzda aktiviteler düzenlenmesini düşünüyor musunuz?

2.3 Authentic Assessment

Bölümüzde verilen derslerde ölçme/değerlendirme hangi yolla yapılıyor?
Projeler, portfolyolar, sözlü sunumlar gibi otantik yollar kullanılıyor mu?

2.4 Staff Capacity

Bölümünüz bünyesindeki öğretim üyelerinin STEM konusundaki kapasitelerini nasıl değerlendirirsiniz?
STEM konusunda çalışma yapan bölümünüz bünyesinde öğretim üyeleriniz var mı?
Öğrencilerden biri STEM alanında çalışma yapmak isterse, bu konuda birlikte çalışabileceği öğretim üyesi/üyeleri var mı?

Domain III – Strategic Partnership

3.1 STEM Partnership

BILTEMM fakülte bünyesinde bir merkez mi? Fakülteye entegre bir kuruluş var mı?
Fakülte BILTEMM ile mi çalışıyor mu? Fakültedeki hocalar BILTEMM ile çalışıyor mu?
BILTEMM'e fakültenin bakış açısı, onlara destek olma derecesiyle ilgili ne söylersiniz?
BILTEMM'in çalışma yapma talebine fakülte olumlu yaklaşıyor mu?

Domain IV – STEM College and Career Readiness

4.1 STEM Path Preparation for Elementary School

4.2 Access to STEM college and career oppotunities for middle and high school students

4.3 Planning Student Outreach and Support for Pre-K-12 STEM Initiatives

Öğrencilere STEM alanındaki kariyer fırsatlarından bahsetmek amacıyla fakültenizde bilgilendirme, sunum ya da farklı etkinlikler yapılıyor mu?
Fakültede yüksek lisans ve doktora öğrencilerini çekebilmek amaçlı onların da yer alabileceği STEM alanında çalışmalar, projeler yürütülüyor mu?

Okullara STEM lideri yetiştirmek ya da STEM alanında yetkin sayılabilmek amaçlı bu yönde spesifik bir yüksek lisans ya da doktora programı var mı? Ya da düşünülüyor mu?

D - Interview Questions of Students

Domain I – School Vision and Structure for Success

1.1 STEM Mission and Vision

Daha önce STEM'i duymuş muydunuz? Ne olduğunu biliyor musunuz?
STEM eğitimi verilmesi hakkındaki düşünceleriniz neler?
Sizce ders aldığın öğretim üyeleri STEM eğitimini önemli buluyorlar mı?

Sizce bölüm vizyon ve misyonları arasında STEM eğitimi yer alıyor mu?
Öğretim hayatında, bölüm tanıtımlarında veya etkinliklerinde bununla ilgili bir bilgiye rastladın mı?

1.2 STEM-centric Culture

Aldığınız dersler inter ya da trans disipliner şekilde mi işleniyor?
Bölümdeki derslerin içeriğinde STEM'in dört farklı alanından (Bilim, Teknoloji, Mühendislik, Matematik) hangilerine değiniliyor?
Proje tabanlı eğitim ya da mühendislik uygulamaları aldığınız derslerde yer alıyor mu?
Aldığınız derslerde teknoloji entegrasyonu yapılıyor mu?
Bölümde STEM eğitimine uygun şekilde dizayn edilmiş sınıflar ya da laboratuvarlar bulunuyor mu?

1.3 STEM Program Evaluation

Okumakta olduğunuz bölüm programınıza STEM'in ne oranda entegre edildiğini düşünüyorsunuz?

Domain II – STEM Curriculum, Instruction, and Assessment

2.1 Academic Rigor and Instructional Quality

Bölümünüzde verilen eğitim öğrenci merkezli bir şekilde mi veriliyor?
Siz öğrenme sürecinin içinde aktif bir şekilde rol alabildiğinizi düşünüyor musunuz?

2.2 STEM-centric Curriculum

Aldığınız derslerin işlenişinin, STEM eğitimiyle ne derece örtüştüğünü düşünüyorsunuz? Bu derslerde sizlere günlük hayattan problemler vererek, sizden bu problemlere STEM sentezine uygun bir şekilde bilimsel altyapınızı kullanıp, sürece teknolojiyi de entegre edecek şekilde çözüm üretmeniz isteniyor mu?

STEM eğitimi üzerine bir ders programınızda yer alıyor mu ya da seçmeli ders olarak alma şansınız var mı?
Derslerin dışında STEM, STEM eğitimi ve benzer içeriklerde aktiviteler bölümünüzde ya da fakültede düzenleniyor mu?

2.3 Authentic Assessment

Aldığınız derslerde ölçme/değerlendirme hangi yolla yapılıyor?
Projeler, portfolyolar, sözlü sunumlar gibi otantik yollar kullanılıyor mu?

2.4 Staff Capacity

Bölümünüz bünyesindeki öğretim üyelerinin STEM konusundaki kapasitelerini nasıl değerlendirirsiniz?
STEM alanında bir çalışma yapmak isteseniz, bu konuda birlikte çalışabileceğiniz öğretim üyesi/üyeleri var mı?

Domain III – Strategic Partnership

3.1 STEM Partnership

Fakülte ya da bölümünüz ile ortak şekilde çalışan bir kuruluş, bakanlık, iş yeri, topluluk veya başka bir üniversiteden haberdar mısınız?
Haberdar iseniz bunlar neler ve ne şekilde bir ortaklığa gidilmiş durumda?

Domain IV – STEM College and Career Readiness

4.1 STEM Path Preparation for Elementary School

4.2 Access to STEM college and career oppotunities for middle and high school students

4.3 Planning Student Outreach and Support for Pre-K-12 STEM Initiatives

Sizlere STEM alanındaki kariyer fırsatlarından bahsetmek amacıyla fakültenizde bilgilendirme, sunum ya da farklı etkinlikler yapılıyor mu?
Sizleri yüksek lisans ve doktoraya teşvik edebilecek içerisinde yer alabileceğiniz STEM alanında çalışmalar, projeler yürütülüyor mu ve duyurusu sizlere yapılıyor mu?
Fakültenizde okullara STEM lideri yetiştirmek ya da STEM alanında yetkin sayılabilmek amaçlı bu yönde spesifik bir yüksek lisans ya da doktora programı var mı? Yoksa düşünülmesi gerekli olur mu?