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Öğretmen Adaylarının FeTeMM Öğretim Yönelimlerinin Anabilim Dalına ve Sınıf Düzeyine Göre İncelenmesi

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ÖZET

FeTeMM eğitiminin, 2017 yılından itibaren fen ve matematik öğretim programında yer aldığı söylenebilir. FeTeMM eğitiminin öğretim programında yer almasıyla, öğretmen adaylarının FeTeMM öğretim yönelimlerinin araştırılması önemli hale gelmiştir. Çünkü öğretim programlarının uygulayıcıları bugünün öğretmen adayları olacaktır. Bunun yanında nitelikli bireylerin yetişmesinde FeTeMM eğitimi önemli bir yere sahiptir. Bu kapsamda sınıf, fen bilimleri ve matematik öğretmen adaylarının öğrenimleri boyunca FeTeMM öğretim yönelimlerinin belirlenmesi önem arz etmektedir. Bu araştırmanın amacı; fen bilimleri, matematik ve sınıf öğretmeni adaylarının FeTeMM öğretim yönelimlerini belirlemektir. Çalışmada nicel araştırma yöntemlerinden ilişkisel tarama modeli kullanılmıştır. Çalışma 2017-2018 eğitim-öğretim yılı güz döneminde gerçekleştirilmiştir. Çalışmaya üç farklı anabilim dalında toplam 521 (354 kadın, 167 erkek) öğretmen adayı katılmıştır. Öğretmen adaylarının STEM öğretim yönelimlerini belirlemek için veri toplama aracı olarak Lin ve William (2015) tarafından geliştirilen ve Hacımeroğlu ve Bulut (2016) tarafından Türkçe uyarlaması yapılan "FeTeMM öğretim yönelimi" ölçeği kullanılmıştır. Veriler, PASW İstatistik 18 ve LISREL 8.80 istatistiksel paketler kullanılarak analiz edilmiştir. Öğretmen adaylarının toplam FeTeMM öğretim yönelim ölçek puanlarının anabilim dallarına göre değiştiği bulunmuştur. Bu anlamlı fark, fen bilimleri öğretmen adayları lehindedir. FeTeMM öğretim yönelim puanları fen bilimleri ve sınıf öğretmeni adaylarının, matematik öğretmeni adaylarından daha iyi olduğunu ortaya koymaktadır. Öğretmen ve öğretmen adaylarının FeTeMM öğretim yönelimlerini arttırmak için bu konuda daha fazla çalışmanın yapılması önerilmektedir.

Anahtar Kelimeler: Disiplinlerarası Eğitim, FeTeMM, Öğretmen Adayları, Öğretim Yönelimleri.

Geniş Özet

Amaç

21. yüzyılda FeTeMM eğitimini neredeyse günlük yaşamın her alanında görmek mümkündür. Çünkü FeTeMM eğitimi, insanlığın mevcut ve gelecek sorunlarına çözüm bulmada önemli rol oynayacağı ifade edilmektedir (Brophy, Klein, Portsmore ve Rogers, 2008; National Research Council [NRC], 2012). Toplumların refah seviyelerine çıkmalarında; fen,

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matematik, mühendislik ve teknoloji alanında yetişmiş bireylerin önemli yer tutmakta olduğu aşikârdır. FeTeMM eğitimi; fen, teknoloji, matematik, mühendislik alanlarının bilgi, beceri ve düşüncelerinin mühendislik temelli öğretimidir. FeTeMM eğitiminin etkili bir şekilde yapılabilmesi için önemli bir role sahip olan öğretmen, öğretmen adaylarının bu konularda daha donanımlı ve bilgili bireyler olmaları için eğitim fakültelerinde FeTeMM eğitimi ile ilgili çalışmaların artırılması gerektiği alan yazında vurgulanmaktadır (Akaygün ve Aslan-Tutak, 2016; Tezel ve Yaman, 2017). Öğretmen adaylarının FeTeMM eğitimi açısından donanımlı yetişmeleri, öğretmen olarak göreve başladıklarında nitelikli bireylerin yetiştirilmesinde önemli görevleri olması ile açıklanabilir. Çünkü geleceğin mühendisini, bilim insanını ve matematikçisini yetiştirecek olan öğretmenlerdir. Bundan dolayı sınıf, fen bilimleri ve matematik öğretmen adaylarının öğrenimleri boyunca FeTeMM öğretim yönelimlerinin belirlenmesi önem arz etmektedir.

Diğer taraftan öğrencilerin FeTeMM eğitiminde, ortaokul kademesinde görev yapan öğretmenlerin büyük bir öneme sahip olduğu söylenebilir. Fen bilimleri ve matematik öğretim programlarında FeTeMM eğitimine vurgu yapılmıştır (Milli Eğitim Bakanlığı [MEB], 2017). Özellikle bu öğretim kademesinde görev yapan fen bilimleri ve matematik öğretmenlerine FeTeMM'in öğretimi konusunda büyük görevler düşmektedir. Bunun için fen bilimleri ve matematik öğretmen adaylarının öğrenim gördükleri programlarda FeTeMM eğitimi ve öğretmen adaylarının FeTeMM öğretim yönelimleri araştırılmaya başlanmıştır. Sınıf, fen bilimleri ve matematik öğretmen adaylarının, öğretmen olarak atandıklarında öğrencilere FeTeMM konusunda rehberlik yapmaları ve FeTeMM temelli ders anlatmaları beklenmektedir. Dolaysıyla bu araştırmanın amacı; fen bilimleri, matematik ve sınıf öğretmeni adaylarının FeTeMM öğretim yönelimlerini belirlemektir. Bu amaç doğrultusunda aşağıdaki araştırma sorularına cevap aranmıştır.

1. Sınıf öğretmeni, fen bilimleri ve matematik öğretmeni adaylarının FeTeMM öğretim yönelimleri öğrenim gördükleri anabilim dalına göre değişmekte midir?

2. Sınıf öğretmeni, fen bilimleri ve matematik öğretmeni adaylarının FeTeMM öğretim yönelimleri öğrenim gördükleri sınıf seviyesine göre değişmekte midir?

Yöntem

Bu çalışmada nicel araştırma yöntemlerinden ilişkisel tarama modeli kullanılmıştır. İlişkisel tarama modeli, en az iki değişken arasındaki birlikte değişimin varlığını ve/veya derecesini tespit etmeye yarayan araştırma yöntemidir (Karasar, 2017).

Örneklem

Sınıf, matematik ve fen bilimleri öğretmeni adaylarının FeTeMM öğretim yönelimlerinin tespit edilmesi amaçlanmıştır. Bu çalışmada veriler, 2017-2018 eğitim öğretim yılı güz döneminde ilgili bölümlerde 1., 2., 3. ve 4. sınıfta öğrenim görmekte olan 521 (354 kadın, 167 erkek) öğretmen adayının katılımı ile iki haftalık sürede toplanmıştır. Çalışma grubu, zaman kaybını önleme, verilere kolay ulaşabilme gibi nedenlerle uygun örnekleme (convenient sampling) yönteminin kullanılmıştır. Katılımcılar tamamen FeTeMM içeriğine uygun olarak hazırlanmış ders almamışlardır. Ancak öğretmen adaylarının; özel öğretim yöntemleri, bilim uygulamaları, matematik, bilgisayar, fen ve teknoloji öğretimi, genel kimya ve genel biyoloji öğretimi gibi derslerde bu uygulamalara örnek teşkil edecek deneyimler yaşamış oldukları düşünülmektedir. Örneklem grubunun bu üç anabilim dalının seçilmesinde, güncellenen fen bilimleri ve matematik dersi öğretim programında FeTeMM eğitimine yer verilmesi etkili olmuştur (MEB, 2017).

Veri Toplama Aracı

Veri toplama aracı olarak Lin ve William (2015) tarafından geliştirilen ve Hacımeroğlu ve Bulut (2016) tarafından Türkçe uyarlaması yapılan "FeTeMM öğretim yönelimi" ölçeği kullanılmıştır. Ölçeğin Türkçe versiyonu 31 sorudan ve 5 alt boyuttan oluşmaktadır. Bu boyutlar: bilgi, değer, tutum, subjektif normlar ve algılanan davranış yönelimidir.

Veri Analizi

Bu çalışmada toplanan veriler için yapılan güvenirlik analizi sonucu ölçeğin alt boyutlarının Cronbach alpha katsayıları 0.68 ile 0.93 arasında değiştiği görülmektedir. Ölçek 7'li likert tipindedir (1:Kesinlikle katılmıyorum, 7:Kesinlikle katılıyorum). Veriler PASW 18 istatistik programı ile analiz edilmiştir (Jöreskog & Sörbom 2006).

Bulgular

Birinci araştırma sorusunda öğretmen adaylarının FeTeMM öğretim yönelimlerinin öğrenim gördükleri bölüme göre değişip değişmediği sonucu araştırılmıştır. Yapılan analizler üç bölümün FeTeMM öğretim yönelimlerinde anlamlı bir fark olduğunu $F(10, 1028)=7.8$, $p=.00$, Wilks Lambda =.986, partial eta square=.07) göstermektedir. Farkın etki büyüklüğünü ifade eden eta kare değerinin .07 olduğu, yani farkın %7 sinin öğrenim görülen anabilim dalında kaynaklandığı yorumu yapılabileceği görülmektedir. Farklılığın hangi anabilim dalından kaynaklandığını analiz etmek için yapılan testlerde fen bilimleri öğretmen adaylarının "bilgi" boyutunda matematik ve sınıf öğretmen adaylarından daha yüksek puan elde ettikleri görülmüştür. Değer, tutum, davranış yönelimi boyutlarında ise fen bilimleri ve sınıf öğretmen adaylarının matematik öğretmen adaylarından daha yüksek puan elde ettikleri görülmüştür. Sübjektif normlar boyutu için bölümler arası fark tespit edilmemiştir.

İkinci araştırma sorusunda öğretmen adaylarının öğretim yönelimlerinin sınıf seviyesine göre değişip değişmediği cevaplanmaya çalışılmıştır. Bulgular sınfı seviyesinin öğretim yönelimi üzerinde anlamlı bir etkisi olduğu yönündedir F(15, 1416)=1.89, p=.02, Wilks Lambda =.94, partial eta square=.018. Ancak bu anlamlı etkinin büyüklüğüne bakıldığında yalnızca %1.8 farkın sınıf seviyesinden kaynaklandığı görülmektedir. Bulgular birinci sınıf öğretmen adaylarının FeTeMM öğretim yönelimlerinin diğer sınıf seviyelerindeki öğretmen adaylarından daha yüksek olduğunu göstermiştir (F (3,517)= 4.17, p=.006, eta square=.024).

Tartışma ve Sonuç

Öğretmen adaylarının FeTeMM öğretim yönelim ölçeğinden aldıkları toplam puanların öğretmen adaylarının devam ettikleri anabilim dalına göre değişmekte olduğu tespit edilmiştir. Bu anlamlı fark, fen bilimleri ve sınıf öğretmenleri adayları lehindedir. Elde edilen bulgular, fen bilimleri ve sınıf öğretmen adaylarının FeTeMM öğretim yönelimlerinin, matematik öğretmen adaylarına göre daha yüksek olduğunu ortaya koymaktadır. Çalışmada elde edilen bulguların, fen bilimleri öğretmen adaylarının özel öğretim yöntemleri I ve II dersinde FeTeMM eğitimine değinilmiş olmasından kaynaklandığı düşünülmektedir. Sınıf öğretmen adaylarının ise, fen ve teknoloji öğretimi I-II dersinde öğretim programlarında yapılan değişikliklerde bahsedilirken, FeTeMM eğitiminin, programlarda yer almasının gerekçelerini detaylı olarak açıklamış olması ile açıklanabilir. Bunun yanında fen bilimleri ve sınıf öğretmen adaylarının öğrenim gördüğü süre içinde almış olduğu derslerde yapılan projelerin de etkili olduğu söylenebilir. Nitekim alan yazında proje konularının üniversite öğrencilerinin mühendislik tasarımlı eğitim üzerinde etkili olduğuna dair çalışmalar bulunmaktadır. Tseng, Chang, Lou & Chen (2013), üniversite öğrencileri ile yapmış oldukları çalışmada, FeTeMM eğitimi ile bütünleştirilen proje tabanlı öğrenme etkinliklerinin, öğrencilerin mühendisliğe karşı olan tutumlarını olumlu yönde etkilediğini saptamışlardır. Öğrencilerin birçoğu fen ve mühendislik disiplinlerinde FeTeMM'in önemli olduğunu belirtmişlerdir. Alanda yapılan diğer bir çalışmada ise; Bers ve Postmore (2005), etkili bir fen öğretimi için yeni yaklaşımlar, yöntem ve tekniklerin öğretmen adaylarına ve öğretmenlere öğretilmesi gerektiği vurgulamışlardır. Benzer şekilde Bakırcı ve Karışan (2018), öğretmen adaylarının FeTeMM farkındalığını araştırmışlardır. Fen bilimleri ve sınıf öğretmen adaylarının FeTeMM farkındalıklarının matematik öğretmenlerine göre daha iyi olduğu sonucuna ulaşmıştır. FeTeMM eğitimi konusunda öğretmen adayları ile ilgili yapılan çalışmanın sonuçları, bu çalışmada elde edilen sonuçları destekler nitelikte olduğunu göstermektedir (Akaygun ve Aslan-Tutak, 2016; Bozkurt, 2014; Gökbayrak ve Karışan, 2017).

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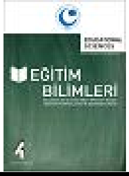

Exploration of Preservice Teachers' STEM Teaching Intentions with respect to the Department and Grade

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ABSTRACT

STEM education included in undergraduate science and mathematics education program in 2017. Inclusion of STEM education in teacher education programs higlights the importance of the investigating the preservice teachers STEM teaching intentions. In this scope, it is important to determine STEM teaching intentions of preservice primary, science and mathematics teachers. This research aims to identify the preservice primary school, mathematics, elementary science teachers' STEM teaching intentions. In this study, relational screening model was used. The study was conducted in fall semester of 2017-2018 academic year. A total of 521 (354 woman, 167 man) preservice teachers from three different departments enrolled in the study. The questionnaire, developed by Lin and William (2015) and adapted to Turkish by Hacımeroğlu and Bulut (2016) was used to assess preservice teachers' STEM teaching intentions. Data was analyzed by using PASW Statistics 18 and LISREL 8.80 statistical packages for windows. It was found that preservice teachers' STEM teaching intentions vary according to their field of education. This significant difference is in favour of preservice science teacher. Findings reveal that preservice science and primary school teachers STEM teaching intentions are better than preservice mathematics teachers. It is suggested that more studies are needed to determine inservice and preservice teachers' STEM teaching intentions to identify what can be done to increase their teaching intentions.

Keywords: Interdisciplinary Education, STEM, Preservice Teacher, Teaching Intentions

Introduction

Technological innovations are largely responsible for the economic development of the countries. In this century, it is possible to educate future engineers and science specialists with spreading science and technology literacy (Miaoulis, 2009; National Research Council [NRC], 2012). Therefore, many countries have focused on Science, Technology, Engineering, Mathematics (STEM) education, a new educational approach to meet the needs of manufacturers and engineers. STEM education, which is based on the integration of Science, Technology, Engineering and Mathematics have been recently included into many countries curricula (Bybee, 2010; Çorlu, 2014;

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Marginson, Tytler, Freeman & Roberts, 2013). STEM education brings daily life problems to the classroom those aim to develop students' ability to differentiate, apply and integrate science, technology, engineering and mathematical concepts for understanding and solving complex problems (Balka, 2011; Vasquez, Sneider & Comer, 2013). Students will obtain information directly through primary resources thanks to the integration of real life problems into classroom environment which enhances their critical thinking skills (Carvalho, Fíuza, Conboy, Fonseca, Santos, Gama & Salema, 2015). STEM education attracts many educators in national (Bakırcı & Karışan, 2018; Çorlu, Capraro & Capraro, 2014; Pekbay, 2017; Zengin, 2016) and international fields (Brown, 2012; Rinke, Gladstone-Brown, Kinlaw & Cappiello, 2016; Roehrig, Moore, Wang & Park, 2012) because of its significant contributions to students' analyzing, and solving real life problems and understanding the background of the current innovations.

STEM education is an interdisciplinary approach that aims to teach science, technology, engineering and mathematics in an integrated way (Bybee, 2010; Çorlu, Capraro & Capraro, 2014; Güder & Gürbüz, 2018). The Ministry of National Education [MoNE] in Turkey has stated that STEM education is an interdisciplinary approach that should be include from the kindergarten (Ata-Aktürk, Demircan, Şenyurt, Çetin, 2017) to the university (Bakırcı & Karışan, 2018). Likewise, in the STEM report, it is pointed that STEM education is a priority in order to increase the academic achievement of the students that international examinations such as PISA and TIMSS. In these international examinations, it has been determined that Turkish students are not successful in science and mathematics, which are two disciplines of STEM education (Akgündüz, Aydeniz, Çakmakçı, Çavaş, Çorlu, Öner & Özdemir, 2015). On the other hand, it was emphasized that STEM education should be given in early education periods such as primary and middle schools (Ata-Aktürk et. al., 2017; Kimmel, Carpinelli & Rockland, 2007) and that STEM skills of students should be developed at an early age (Robinson, Dailey, Hughes & Cotabish, 2014). In the light of these results, it can be said that it is necessary to educate teachers who are responsible for the integration of different disciplines in the classroom (Ahmad, Shaharim & Abdullah, 2017) from this point it is important to determine the intentions preservice primary school, elementary science and mathematics teacher's STEM teaching intentions whom will be future teachers in primary and elementary schools. At this level of instruction students will still be at an early age. Thus, teachers will take an active role in the teaching of STEM fields and in directing students to these disciplines.

The studies on STEM education are rapidly increased in Turkey. Some studies concluded that STEM based science education has increased students' achievement on force and motion subjects (Ercan & Şahin, 2015; Güder & Gürbüz, 2018); science and engineering applications in science education have contributed positively to students' awareness of science literacy and career in the field of science (Çınar, Pırasa, Uzun & Erenler, 2016; Savran-Gencer, 2015); STEM education and engineering applications have increased the academic achievement of preservice science teachers in science laboratory course (Yıldırım & Altun, 2015); and STEM spot development activities have improved students' knowledge and skills in technology and computer subjects (Baran, Canbazoğlu-Bilici & Mesutoğlu, 2015). In addition, it has been determined that engineering based science teaching is influential on the science process skills of preservice science teachers (Gökbayrak & Karışan, 2017; Sungur-Gül & Marulcu, 2014).

Within STEM education, students learn how scientific research-inquiry and design development dimensions are combined, how information is obtained and how real-world problems are solved (Bozkurt, 2014; Gürbüz, Çavuş-Erdem, Şahin, Temurtaş, Doğan, Doğan, Çalık & Çelik, 2018). The positive effects of STEM education on students have led to redesign curriculum in many countries particularly the United States, Russia, Japan and China (Bakırcı & Karışan, 2018). STEM education has been included to Science and Mathematics curricula in Turkey since 2017 (MoNE, 2017). Since practitioners of curricula are teachers, it is necessary to determine in service and preservice teachers' existing knowledge on STEM education and to train them. In Bracey and Brooks (2013) study conducted with preservice teachers; the collaborative program on science, technology, engineering and mathematics has found that participants have developed positive perceptions of self-efficacy and attitudes towards science. In another study, Yıldırım and Altun (2015) found that engineering applications and STEM education were effective for developing preservice science teachers' science understandings. Bozkurt, Altan, Yamak and Buluş-Kırıkkaya (2016) reached the conclusion that design-based science education increased the science motivation of preservice teachers and developed their questioning skills. Previous literature states that STEM education has positive effects on preservice teachers.

STEM education has contributed to the development of many skills such as creativity, imagination, empathy, responsibility, cooperation and trust in students (Bybee, 2010; Roehrig, Moore, Wang & Park, 2012) and, STEM education has been found to be effective on students' learning (Becker & Park, 2011). In addition, teachers have stated that STEM activities helps students to gain 21th century skills and students have stated that STEM activities simplify the scientific context (Thananuwong, 2015). Likewise, Yamak, Bulut and Dündar (2014) found that STEM activities have improved scientific process skills of fifth grade students and have an impact on attitudes towards science lessons. A similar study on this subject was conducted by Ceylan (2014), which concluded that the STEM approach was effective in teaching the acid-base topic. When the results of STEM-based studies are noted, STEM-based science teaching provides students with knowledge of multiple solutions to a problem, high-level thinking, questioning, using scientific process skills and collaborative work skills (Ercan & Bozkurt, 2013; Marulcu, 2010; Roehrig et. al., 2012; Schnittka & Bell, 2011). Moreover, it was determined that STEM improves students' problem-solving skills, enabled them to learn science concepts, increased their motivation, and their decision-making skills (Denson, 2011; Jonansen, 2011). With the inclusion of STEM education to the curriculum, teachers have a great responsibility in this regard. Thus, it is important that preservice teachers', as they became future teachers, STEM skills are important to explore. Especially, preservice primary school, science and mathematics teachers' whose major area (science, math, life sciences) are directly linked to the STEM fields.

Undergraduate education has an important place for teachers to be equipped professionally. Science, mathematics, and primary school teachers are teachers who work at basic levels of education. It is believed that preservice teachers who are equipped with qualified STEM education will make effective teaching in this regard when they became a teacher (Bakırcı & Karışan, 2018). An effective STEM education will lead to increase knowledge, motivation and interest of students about these disciplines (Bozkurt-Altan et. al., 2016). At the same time, teachers with knowledge and experience of STEM education will play an active role in choosing the profession of their students (Hacıömeroğlu, 2017). In this context, it is believed that it is important to reveal preservice teachers thoughts on STEM education. Primary school teachers are responsible for teaching science and mathematics to 1-4 graders. However, it has been noted that preservice primary school teachers do not have sufficient knowledge about STEM education (Gürbüz, et. al., 2018; Hacıömeroğlu, 2017).

Most of the students experience the STEM related activities in primary school years. If primary school teachers are qualified in teaching STEM, students will have good experience in this area. Therefore, it is important to investigate the preservice primary school teachers STEM teaching intentions. Preservice teachers should be engaged in various tasks, courses and seminars in order to graduate with complete understanding of STEM. On the other hand, emphasis on STEM education in science and mathematics curricula provides a major task for elementary teachers (MoNE, 2017). To this end, STEM teaching intentions of preservice science and mathematics teachers have begun to be investigated. It is expected that preservice primary school, science and mathematics teachers should guide students on STEM when they are appointed as teachers and design STEM-based lessons. Thus, it can be said that it is important to put forward the STEM teaching intentions in this research.

In the 21st century it is possible to see the STEM education in almost every aspect of daily life. Thus, it is stated that the STEM education will play an important role in finding solutions to the present and future problems of mankind (Brophy, Klein, Portsmore & Rogers, 2008; NRC, 2012). It is evident that individuals trained in science, mathematics, engineering and technology have an important place in society's prosperity. It is emphasized that studies on STEM education should be enhanced in education faculties' curricula in order to have more equipped and knowledgeable individuals (Akaygün & Aslan-Tutak, 2016; Tezel & Yaman, 2017). It can be said that the societies' competitiveness in science and technology is related to the individuals trained in STEM disciplines. Teachers will train the future engineers, scientists and mathematicians. In this context, it is important to determine STEM teaching intentions throughout the education of preservice primary school, science and mathematics teachers. Therefore, in the present study, the purpose was to investigate the preservice science, mathematics and primary school teachers STEM teaching intentions. For this purpose, the following research questions were sought.

Are there any differences among preservice science, mathematics and primary school teachers' STEM teaching intentions?

Are there any differences among preservice science, mathematics and primary school teachers' STEM teaching intentions with respect to grade level?

Method

Research Design

Cross sectional survey method, which is a type of quantitative research method, was used to determine preservice primary school, mathematics, elementary science teachers' STEM Teaching Intentions. A cross-sectional survey collects information from a sample that has been drawn from a predetermined population. Furthermore, the information is collected at just one point in time, although the time it takes to collect all of the data may take anywhere from a day to a few weeks or more (Fraenkel, Wallen & Hyun, 2011). The study was conducted in fall semester of 2017-2018 academic year. Data collection procedure took 2 weeks. The instrument was administered to the participants after getting permission from the faculty administration. The same researcher collected the data and explained the aim of the study at the beginning of the data collection procedure. Preservice teachers completed the instrument during 15-20 minutes periods.

Participants

A total of 521 (354 women, 167 men) preservice teachers from three different departments (primary school, mathematics, elementary science) enrolled in the study. Data were collected from all grade from freshman to senior. The primary reason for selecting these three departments' students can be explained as they will be responsible for teaching at least one of STEM areas. Elementary science teachers will teach science, mathematics teachers will teach mathematic and primary teachers will be responsible for both science and mathematics. 39% of the participants were preservice primary teachers, 37% elementary science and, 23% were preservice elementary mathematic teachers. Participants' age ranged between 17 to 25. The majority of the participants were senior students and 22 years old.

STEM is new context for undergraduate programs. Although it is included elementary science textbooxs (at the end of the book, as a distinct unit) it was not included in undergraduate programs. So, majority of preservice teachers' STEM backgrounds were not in advance level when the data was collected. However, they became familiar with STEM through their method courses. Method courses, in general, shaped by the context of elementary textbooks, preservice teachers had to take into consideration of the contexts of those boks while planning their micro teaching. In addition to method courses they also have another courses in which they analyze the science/math curriculum. Thus, preservice teachers may gain some vision about STEM in such courses. However, the researchers do not claim that participants have official and adequate STEM background when the data was collected. Results of the study should be evaluated by this limitation.

Data Collection Tool: STEM Teaching Intention Questionnare (STEM-TIQ)

A seven-point likert type instrument developed by Lin and Williams (2015) and adapted into Turkish by Hacıömeroğlu and Bulut (2016), was used to assess preservice teachers' STEM teaching intentions. The validity and reliability of the adaptation study was only tested by preservice primary teachers. Current study distincts from this adaptation study by its participants. Hacıömeroğlu and Bulut (2016) was acknowledged that data will be collected from preservice science, math and primary teachers while taking permission for scale use. Due to the small differences between the target participants of the studies, current study re-conducted confirmtory factor analysis to explore whether the scale is valid and reliable for present study.

The original scale consists of 31 questions and six subscales which are; Knowledge (4 items), Value (5 items), Attitude (6 items), Subjective norms (6 items), Perceived Behaviour control (5 items), Behavioral intention (5 items). Whereas two subscales (perceived behavioral control and behavioral intention) were merged in Turkish version. Thus, the adapted version has five subscales (knowledge, value, attitude, subjective norms, perceived behaviour & behavioural intention). Confirmatory factor analysis and reliability analysis showed that the scale has five subscales and the reliability coefficients range between (0.68-0.93) which indicates the scale is valid and reliable. Table 1 shows one sample item for each subscale and their cronbach alpha coefficients for both of the original scale and the present study.

STEM Teaching Intention Questionnaire subscales and their cronbach alpha coefficients inTable 1.

Table 1. STEM Teaching Intention Questionnaire Subscales and Their Cronbach Alpha Coefficients

Subscale	Sample item	α (original scale)	α (present study)
Knowledge	"I am familiar with the Science knowledge in the middle school level (e.g. Newton's laws of motion"	.93	.68
Value	I think it is important to help students in learning how to collect STEM-related data during the learning process	.86	.92
Attitude	I will implement integrative STEM teaching if media advertisements (e.g. newspaper, television) ask me to do this	.87	.86
Subjective norms	In the teaching environment, I think I have enough ability in implementing integrative STEM teaching	.69	.85
Perceived behaviour control and behavioral intention	Students can explore their interest in STEM fields through integrative STEM teaching	.86	.93

The Cronbach alpha coefficients were found to be sufficiently high to conduct further analysis for all of the subscales with one exception, which are, knowledge (α=.68). It is necessary to highlight that the reliability coefficient for knowledge was somewhat low but acceptable for educational studies (Taber, 2017).

Although it is not possible to detect in which courses or experiences directly contributed to the preservice teachers' STEM teaching intentions we would like to summarize the STEM related lessons that might contribute the students' teaching intentions. Table 2 represents authors assumptions about the undergraduate courses which might effect preservice teachers STEM teaching intentions direct or indirect way.

Table 2. Undergraduate Courses which are Directly/Indirectly Effect PTs STEM Teaching Intentions

Courses	Science	Mathematics	Classroom Teacher
1st grade	Educational science Information techology Physics Chemistry Biology Calculus	Educational science Information technology Calculus History of math	Educational science Information technology Mathematics for primary school Science for primary school
2nd grade	Teaching principles and methods Science teaching methods and approaches Physics, Chemistry, Biology Teaching Technologies Science curriculum	Instructional Technologies Teaching principles and methods Math teaching methods and approaches Elementary mathematics	Instructional Technologies Sicence laboratory Teaching principles and methods
3rd grade	Classroom management Science laboratory Science teaching Scientific reasoning	Classroom management Numbers teaching Algebra Mathematic teaching	Classroom management Life science teaching Math teaching Science teaching
4th grade	School experinece İnterdisciplinary science teaching Outdor science learning environment Nature of sciene and teaching	School experience Problem solving Misconception in mathematic İnformal Reasoning Mathematic teaching	School experience

Data Analysis

Data was analyzed by using PASW Statistics 18 and LISREL 8.80 (Jöreskog & Sörbom 2006) statistical packages for windows. Preservice teachers responses to the STEM-TIQ items were coded on a scale of 1 (very strongly disagree) to 7 (very strongly agree) so that higher scores respresents more positive teaching intention. One-way multivariate analysis of variance (MANOVA) was performed to investigate the effects of grade level and department on five subscales.

In order to validate factor structure of the STEM Teaching Intention Questionnaire for their use with Turkish students, Confirmatory Factor analysis (CFA) was conducted. Figure 1 demonstrates the model specification and the parameter estimates.

Results

Descriptive statistics for 521 preservice teachers' were presented in Table 2

Table 3. Descriptive Statistics for Department and Grades

Department	Grade	N	%
Primary School	1	49	9,4
	2	47	9,0
	3	53	10
	4	57	11
Science Education	1	45	8
	2	45	8
	3	46	8
	4	57	11
Mathematics Education	1	28	5
	2	30	5
	3	32	6
	4	32	6
Gender			
	Woman	354	68
	Man	167	32

Confirmatory factor analysis was used to test how well the measured variables represents the number of constructs. LISREL 8.80 for windows (Jöreskog & Sörbom, 2006) with SIMPLIS command was used to conduct CFA. As well as the conventional use of chi square, Normed Fit Indices (NFI), Non-Normed Fit Indices (NNFI), Incremental Fit Indices (IFI), Relative Fit Indices (RFI), Comparative Fit Indices (CFI), Goodness of fit Indices (GFI) and Root Mean Square Error of Aprroximation (RMSEA) were used to evaluate the model. The 31-item scale was subjected to CFA to test five structure of STEM-TIQ. Results showed almost perfect fit to the data. Two of the fit indices (GFI and x2/df) were in optimal range (Kelloway, 1998), rest of them were in perfect range (>.95). These estimates were likely to be evaluated due to large sample size (Tabachnich & Fidell, 2007). Figure 1 demonstrates the model specification and parameter estimates.

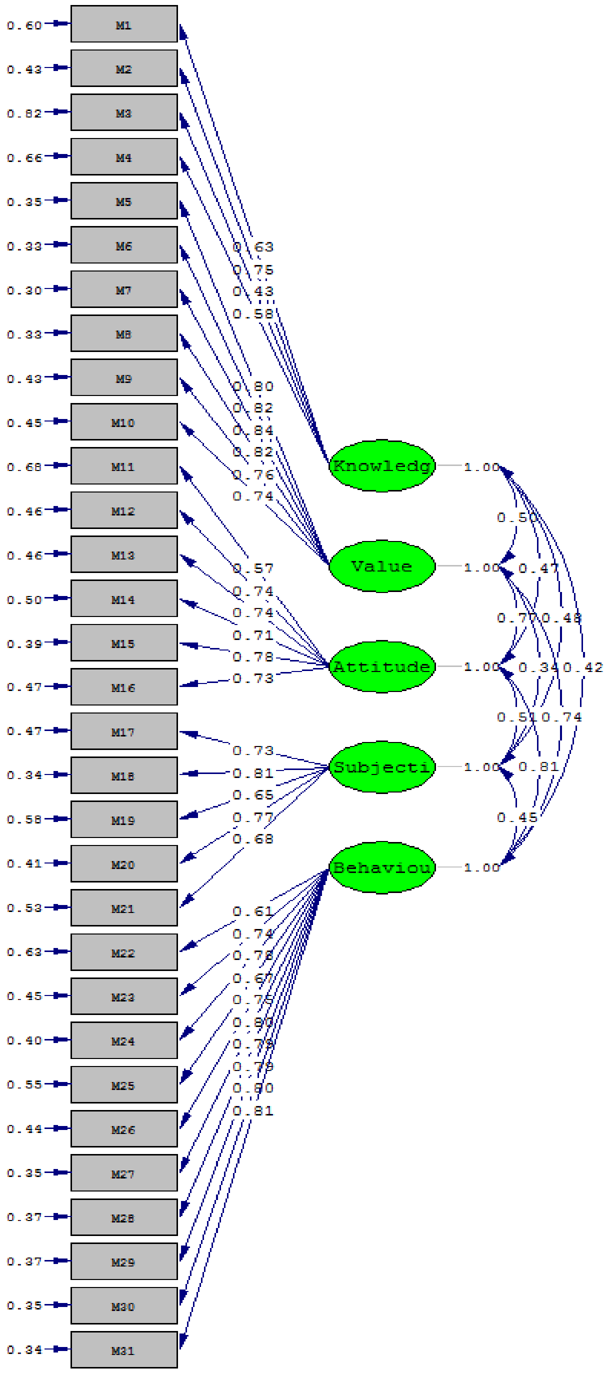

Figure 1 Confirmatory Factor Analysis Diagram for STEM-TIQ Model Fit and Parameter estimates (x2(424)=1367.82, p<.05; NFI=.96; NNFI=.95; IFI=.97; RFI=.96, CFI=.97, GFI=.85, RMSEA=.07; x2/df=3.5).

One-way multivariate analysis of variance (MANOVA) conducted to determine the effects of departments (primary, math, science) and grade (1, 2, 3, 4) on five dimensions of STEM-TIQ.

Table 4. Descriptive Statistics of STEM-TIQ Responses of Different Departments

Subscale	Department	Mean	St. Deviation	N
Knowledge	Science	5.6205	.84282	193
	Math	5.3279	1.15041	122
	Primary	5.2998	1.14961	206
Value	Science	6.1891	.78713	193
	Math	5.7842	1.28916	122
	Primary	6.3212	.78932	206
Attitude	Science	5.8990	.74981	193
	Math	5.4221	1.16936	122
	Primary	5.8463	.86381	206
Subjective	Science	5.1440	1.09591	193
	Math	4.9836	1.25220	122
	Primary	4.9369	1.01985	206
Behavior	Science	6.0306	.67911	193
	Math	5.5254	.97477	122
	Primary	6.1301	.72601	206

Table 5 results showed that there is statistical significant mean difference among three department.

Table 5. MANOVA Test for Departments

	Effect	Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pilllai's Trace	.986	7326. 914[a]	5.000	514.000	.000	.986
	Wilks' Lambda	.014	7326. 914a	5.000	514.000	.000	.986
	Hotellling Trace	71.273	7326. 914a	5.000	514.000	.000	.986
	Roy's largest Root	71.273	7326. 914a	5.000	514.000	.000	.986
Department	Pilllai's Trace	.139	7.715	10.000	1030.000	.000	.070
	Wilks' Lambda	.864	7.788[a]	10.000	1028.000	.000	.070
	Hotellling Trace	.153	7.861	10.000	1026.000	.000	.071
	Roy's largest Root	.120	12.325[b]	5.000	515.000	.000	.107

a: Exact statistic
b: The statistic is an upper bound on F that yields a lower bound on the significance level
c: Design: Intercept + Department

F(10, 1028)=7.8, p=.00, Wilks Lambda = .986, partial eta square= .07. The multivariate eta squared indicates the effect size, and a value of .07 means that only 7% of multivariate variance on the dependent variables was associated with department. Results of the one way MANOVA test for different departments are summarized in Table 5. Significant differences were found among three departments on the four of five subscale scores which are knowledge, value, attitude, behavioral intention. Follow up test was conducted to make pairwise comparison. It was found that preservice science teachers knowledge level was significantly greater than mathematic and primary school teachers. On the other hand preservice science and primary teachers' value, attitude, and behavioral intention levels were significantly greater than preservice mathematic teachers'. Pairwise comparisons for the subjective norm subscale were nonsignificant.

Table 6. Test of Between Subject Effects

Subscales	F	P	Partial eta
Knowledge	5.36	.005	.02
Value	13.10	.000	.05
Attitude	11.64	.000	.04
Behavioral intention	24.87	.000	.08

Critical value for partial eta square were .01 small, .06 medium, .14 large effect size (Cohen, 1988). According to the Cohen's criteria, mean difference among different departments has medium effect size (lower than .14) except knowledge which has small effect size.

Grade

Table 7. Descriptive Statistics of STEM-Tiq Responses of Different Grades

Subscale	Grade	Mean	St. Deviation	N
Knowledge	1	5.4898	1.02721	122
	2	5.3484	1.10855	122
	3	5.4256	1.00513	131
	4	5.4349	1.08360	146
Value	1	6.4989	.84538	122
	2	6.0833	.91218	122
	3	6.1247	.84108	131
	4	6.0080	1.11474	146
Attitude	1	5.8675	.80258	122
	2	5.6107	1.03931	122
	3	5.7926	.89731	131
	4	5.7888	.93900	146
Subjective	1	4.8836	1.19333	122
	2	4.9443	1.16343	122
	3	5.0565	.97073	131
	4	5.1808	1.09099	146
Behavior	1	6.0516	.71861	122
	2	5.8320	.85283	122
	3	5.9534	.83263	131
	4	5.9664	.82163	146

Results showed that there is statistical significant mean difference among different grades F(15, 1416)=1.89, p=.02, Wilks Lambda = .94, partial eta square= .018. Partial eta squared indicates that only 1.8% of multivariate variance on the dependent variables was associated with grade. According to cohen's criteria, partial eta square illustrates that mean difference among different grade levels has small effect size. Statistical significant mean differences was found on only one subscale, Value, among four grades. F(3,517)= 4.17, p=.006, eta square=.024. It was found that 1st grade students' Value levels was significantly greater than other students. All the other pairwise comparisons on the four subscales were nonsignificant.

Discussion and Conclusions

This research aims to identify the STEM teaching intentions of preservice science, mathematics and primary school teachers. The alpha value of the STEM teaching intention scale was calculated as .85 and five sub-scales emerged as a result of the adaptation study. The reliability for four of these sub-scales were found to be between .85 and .93, the knowledge sub scale was found to be .68, which is an acceptable value in educational studies (Taber, 2017). Therefore, STEM teaching intention scale can be seen as a reliable tool and it is assumed that preservice teachers provided sincere and objective responses to the scale questions.

It was found that the total STEM teaching intention scale scores of preservice teachers vary according to their field of education. This significant difference is in favour of preservice science teachers. Findings reveal that STEM teaching intentions of preservice science and primary school teacher are better higher than preservice mathematics teachers. This may be related with the fact that the preservice science teachers are exposed to STEM education in special teaching methods I and II courses. As for primary school teachers, it may be related to the recent changes introduced to science and technology teaching I-II courses and the recent introduction of STEM education into the syllabi of the courses and programs. Also, the projects preservice science and primary school teachers have taken during their education period may have played a role. As a matter of fact, studies show that project topics can have a significant effect. For instance, Tseng et. al. (2013) found that project-based learning activities integrated with STEM education positively influenced students' attitudes towards engineering and many students stated that STEM is important in science and engineering disciplines. Bers and Postmore (2005) emphasized that new approaches, methods and techniques should be taught to inservice and preservice teachers for an effective science teaching. The results of the study focusing on preservice teachers and STEM education support the results obtained in this study.

Tarkın-Çelikkıran and Aydın-Günbatar (2017) studied with pre-service chemistry teachers'; stated that STEM activities gave preservice teachers' interdisciplinary viewpoint, recalling chemistry subject matter knowledge and reinforced their field knowledge. Similarly, Tekerek and Karakaya (2018), pre-service science teachers';

gender, academic achievement score, and the frequency of technology usage, there was no statistically significant difference in STEM awareness. On the other hand, they found that pre-service science teachers differed significantly in their STEM awareness compared to grade.

There was a significant difference between the scores obtained by the preservice teachers in the four subscales of STEM teaching orientation scale (knowledge, attitude, value and behaviour), but no significant difference was found in the subscale of subjective values. The meaningful difference in the knowledge subscale works in favour of science teachers. This indicates preservice science teachers are better than preservice primary school and mathematics teachers in knowledge subscale of STEM teaching intention scale. This may be related to the fact that they took science and maths classes which are STEM related disciplines in their undergraduate education. Another reason could be that preservice teachers tend to synthesize knowledge in first and second year courses such as General Physics, General Chemistry, General Biology and General Mathematics. In this study, this result aligns with the results of other studies in the literature. For example, Elliot, Oty, McArthur and Calark (2001) concluded that interdisciplinary learning approach is effective in improving positive attitudes of university students towards mathematics. On the other hand, no difference is found in terms of problem-solving and critical thinking skills between the students who took mathematics course with a traditional approach and the students who took mathematics course with an interdisciplinary approach. Kızılay (2016) noted that preservice teachers are aware of the benefits of STEM education but he added that they do not know enough about the interrelationships between the fields of STEM education. In another study related to science, Eroğlu and Bektaş (2016) investigated views of science teachers on STEM based teaching activities. Teachers indicated that STEM based education activities are especially appropriate for physics topics and that there is a relationship between science and maths, and engineering and technology.

This research also showed that science and primary school teachers had significant difference in value, attitude and behaviour subscales. This finding suggests that STEM teaching intention of preservice science and primary school teacher is better than preservice mathematics teachers. It is thought that the STEM teaching intention of the preservice science teachers are good because they are given science-technology-design oriented activities in “Selected Topics in Physics” and “Selected Topics in Chemistry” courses. STEM teaching intentions of preservice primary school teachers can be explained by the fact that they take a lot of courses, including basic disciplines during their university education (Basic Mathematics I, General Biology, General Chemistry and Teaching Technologies and Material Design, etc.). For instance, the research of Bozkurt-Altan, Yamak and Buluş-Kırıkkaya (2016) argues engineering design process eases the learning of preservice teachers and also motivates and strengthens the learning process. Likewise, Yıldırım and Altun (2015) found that their work with preservice science teachers was meaningful for the experimental group in which the engineering implementation and STEM education were applied, and that these practices had a positive effect on the achievement of preservice teachers. The work of Tarkın-Çelikkıran and Aydın Günbatar (2017) with preservice chemistry teachers showed that STEM education practices gained them an interdisciplinary point of view and reinforced the learned knowledge and content knowledge. There are also studies in the literature which indicate that preservice teachers are insufficient in developing STEM activities. Kınık-Topalsan (2018) has carried out STEM activities in the scope of Science and Technology Teaching I course with preservice teachers and he pointed out that they showed poor performance in the first and most important step of defining a problem and clarifying an identified problem.

The effect of the significant difference between the scores of the preservice teachers on the subscales of the STEM teaching intention scale was calculated and these values changed between .02 and .08 (see Table 6). The significant differences in the subscales were found in knowledge, attitude, value and behaviour subscales. This shows that preservice teachers feel confident about their content knowledge. Yenilmez and Balbağ (2016) have found that the attitudes of preservice science and mathematics teachers towards STEM are generally positive and preservice science teachers' attitudes towards STEM are generally more positive than those of preservice mathematics teachers. Hacıömeroğlu (2017) indicated that the STEM teaching intention levels of the preservice primary school teachers were generally positive. In addition, it was determined that the opinions of the preservice teachers were positive in the knowledge, attitude, value, subjective and behaviour subscales. In another study, Deveci (2018) found that the preservice science teachers had a significant relationship between STEM awareness and entrepreneurial characteristics. Moreover, the most predicted variable among the entrepreneurial characteristics of STEM awareness was identified as emotional intelligence.

When it was examined if the STEM teaching intentions differ according to the grade level, a significant difference was found among the STEM teaching intention scores [$F_{(15,146)}=1.89$, $p<.05$]. This difference can be seen in 'value' subscale of first year scores. However the value effect is very small. In this case, it can be said that the different courses that preservice teachers have taken during their high school education are influential. As a matter of fact, when the literature is reviewed, it can be seen that the preservice teachers' attitudes towards STEM education are important for high school education. Wang (2013) in his study with preservice teachers on STEM subjects argued that the achievements in high school science and mathematics courses increases students' possibility of choosing STEM subjects to study. No significant difference is found out in other subscales of the STEM teaching intention scale (see Table 5). This means preservice teachers' STEM teaching intention scale scores are similar. This result can be explained by the fact that they may have taken similar courses during university education, participated in extra-curricular activities, signed up for courses from the same instructors and had the same learning environment. Dabney et. al., (2012) conducted a study with 6882 university students to find out the effects of extracurricular activities on STEM professions. As a result of the study, it was found that secondary school activities were influential in choosing STEM professions and they also play a role in determining the interest of students in science and mathematics. Farrior et. al., (2007) have observed that approaches that integrate STEM disciplines make students more willing to understand the use of math practices in everyday life in STEM disciplines.

Implications

In summary, this study, in which STEM teaching intentions of preservice teachers are identified, is a preliminary research for future STEM researchers. Further comprehensives studies can be helpful in presenting an overall picture of preservice teachers' STEM teaching intentions. It is suggested that further studies are needed to determine inservice and preservice teachers' STEM teaching intentions to identify what can be done to increase teaching intentions.

STEM activities can be included in the Scope of Teaching Method Courses which may positively effect preservice teachears STEM teaching intentions.

Moreover, to improve preservice teachers (studying in different majors) STEM teaching orientations, they can be engaged in common STEM projects.

Longitudinal studies should be conducted to get clear understanding of preservice teachers' STEM teaching intentions

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