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Hopelessness and future expectations among gifted middle school students

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ABSTRACT Some characteristics of gifted students may affect their view of the future positively, but some of them may have a negative influence. Therefore, the aim of the present study is to explore future hope and expectations among gifted middle school students. A mixed method was used for this research. Beck Hopelessness Scale and Positive Future Expectations Scale were administered to 65 gifted (41 boys and 24 girls) middle school students. In order to collect the qualitative data, content analysis of these gifted students' writings about future expectation was used. Results showed that there was no hopelessness among gifted students and that they had high positive future expectations. Also, content analysis of their writings supported quantitative measurements in the study.

Keywords *gifted students, hopelessness, future expectations*

Üstün zekâlı ortaokul öğrencilerinde umutsuzluk ve gelecek beklentisi

ÖZ Üstün zekâlı öğrencilerin bazı özellikleri gelecek bakışlarını olumlu etkileyebilecekken bazı özellikleri de olumsuz etkileyebilir. Bu araştırmanın amacı, üstün zekâlı öğrencilerin gelecek umutlarını ve beklentilerini ortaya çıkarmaktır. Karma metodun kullanıldığı bu araştırmada ortaokula devam eden 65 (41 erkek, 24 kız) üstün zekâlı öğrenciye Beck Umutsuzluk Ölçeği ve Olumlu Gelecek Beklentisi Ölçeği uygulanmıştır. Ayrıca niteli verileri toplamak için de öğrencilerin gelecek beklentisi ile ilgili yazdıkları kompozisyonların içerik analizi yapılmıştır. Araştırma sonuçları üstün zekâlı öğrenciler arasında umutsuzluğun olmadığını ve üstün zekâlıların olumlu gelecek beklentisine sahip olduklarını göstermiştir. İçerik analiz de araştırmadaki nicel ölçümleri desteklemiştir.

Anahtar Kelimeler *Üstün zekalı öğrenciler, umutsuzluk, gelecek beklentisi*

GENİŞLETİLMİŞ ÖZET

Araştırmacılar, insanın geleceğe yönelik bakışlarının davranışlarında etkili olduğu belirtmektedirler (Adler, 1994; Husman ve Lens, 1999; Nuttin ve Lens, 1985; Phalet, Andriessen ve Lens, 2004). Geleceğe yönelim, gelecekle ilgili hedefler, umutlar, beklentiler ve kaygılarla ilgili duygu ve düşünceleri ifade etmektedir (Honora, 2002; MacLeod ve Byrne, 1996; Nurmi, 1991; Seginer, 1988). Birçok faktör gelecek yönelimini etkilemektedir (Erikson, 1994; Nurmi 2004; Nurmi, Poole ve Kalakoski, 1994). Umut, gelecekteki hedefleri gerçekleştirme adına olumlu beklentiyi ifade eder (Seber, 1991). Umutsuzluk, birçok problem ve sonuçlar doğurabilir (Carver ve Scheier, 1999; Kashan ve diğ., 1991; Lavender ve Watkins, 2004). Gelecekteki başarıda çocuklukta gelişen geleceğe bakış ve tutkunun etkisi bulunmaktadır (Hidi ve Harackiewicz, 2000; Torrance, 1993).

Üstün zekâlı çocuklar bir hedefi takip etmekten ve gelecekle ilgili düşünmekten keyif alırlar (Perrone, 1997; Torrance, 1978). Üstün zekâlı girişimciler, geleceğe dair olumlu bir vizyona sahiptir ve erken yaşlardan itibaren hedeflerini başararak dünyayı değiştirebilme yeteneklerine ve kendilerine güvenmektedirler (Shavinina, 2009). Hızlı öğrenen ve küçük deneyimlerden bile çıkarımlar yapan bir çocuk, deneyimlerine ve olumlu gelecek hayal etme kapasitesine daha rahat güvenmektedir (Perry, 2002). Kelly (1992), üstün zekâlı çocukların gelecek kariyerleri için diğer çocuklara göre önlerinde daha az engel olduğuna inandıklarını bulmuştur. Üstün zekâlı çocuklar, ilgili oldukları alanlarda tutkuya sahiptirler (Lovecky, 1993). Gelecek problemleri çözme programına katılan üstün zekâlı çocukların bu programa katılmayan öğrencilere göre gelecekle daha fazla ilgilendikleri bulunmuştur (Tallent-Runnels ve Yarbrough, 1992). Üstün zekâlı çocuklar gelecekle ilgili girişimlerde bulunmaktadırlar (Lovecky, 1992; Passow, 1988). Bununla birlikte bazı araştırmacıların üstün zekâlılarla ilgili belirttiği özellikler üstün zekâlı öğrencilerin gelecekle ilgili bakışlarını olumsuz etkileyebilir (Kerr ve Cohn, 2001; Kline ve Short, 1991; Roeper, 1988; Tallent-Runnels ve Yarbrough, 1992; Webb ve diğ, 2007). Örneğin, üstün zekâlı çocuklar dünya problemlerine karşı duyarlı olduklarından dolayı gelecekle ilgili kaygı yaşamaktadırlar (Passow, 1988). Bazı araştırmacılar üstün zekâlı öğrencilerin gelecekle ilgili kötümser olduklarını bulmuştur (George ve Gallagher, 1973; Landua, 1976). Fakat üstün zekâlı öğrenciler diğer akranlarına göre daha fazla çözüme yöneliktirler (George & Scheft, 1998). Bununla birlikte üstün zekalı kız ve erkeklerin gelecekle ilgili farklı beklentileri olduğu belirtilmektedir (Callahan, Cunnigham, ve Plucker, 1994; Schuler, 1999).

Singer'a göre (1974) çocukların gelecek bakışı günümüz başarısını etkileyebilir. Ülkemizde genel öğrenci grubu için gelecek beklentileri ile ilgili araştırmalar (Ceylan ve diğ., 2003; Eryılmaz, 2011; Güler, 2004; İmamoglu ve Edwards, 2007) yapılmasına rağmen üstün zekalı öğrencilerin geleceğe bakışı ile ilgili araştırma bulunmamaktadır. Üstün zekâlı çocukların gelecekle ilgili düşünceleri incelemek bugünkü başarıları adına alınacak önlemler için önem taşımaktadır. Gelecekte toplumlara ve yeniliklere liderlik etme potansiyeline sahip üstün öğrencilerin geleceğe yönelik tutumlarının belirlenmesi bu öğrencilere sunulacak rehberlik ve eğitim hizmetlerini de katkı sağlayacaktır. Bu araştırmanın amacı genellikle "gelecek için umut" (Wilms, 1986) olarak görülen üstün yetenekli öğrencilerin gelecek beklentilerini ve umutsuzluk düzeylerini incelemektir.

Bu araştırmada karma desen kullanılmıştır. Üstün yetenekli öğrencilerin geleceğe yönelik tutumlarının incelenmesinde tarama modeli uygulanmıştır. Ayrıca çalışmada, araştırmaya katılan üstün zekalı öğrencilerin geleceğe ilişkin görüşlerini yazdıkları kompozisyonların içerik analizi yapılmıştır. Araştırmaya, üstün zekâlılara yönelik özel sınıfa devam eden 41 erkek ve 24 kız olmak üzere 65 ortaokula devam eden (5-8. Sınıf) üstün zekâlı öğrenci katılmıştır. Araştırmada, Olumlu Gelecek Beklentisi Ölçeği (İmamoğlu, 2001) ile Beck Umutsuzluk Ölçeği (Beck ve diğ., 1974) uygulanmıştır. Ayrıca öğrencilere gelecekle ilgili beklentileri hakkında bir de kompozisyon yazdırılmıştır. Öğrencilerin yazdıkları kompozisyon nitel analiz yöntemleriyle; diğer ölçekler nicel yöntemlerle analiz edilmiştir. Araştırma bulgularına göre, üstün zekâlı öğrencilerin umutsuzluk ölçeğinden aldıkları puan ortalamasına bakıldığında umutsuzluk düzeyinin çok düşük olduğu görülmüştür. Yine üstün zekâlı öğrencilerin olumlu gelecek beklenti ölçeğinden aldıkların puan ortalamasına göre geleceğe yönelik olumlu beklentilerinin yüksek olduğu söylenebilir. Araştırmaya göre umutsuzluk puanları ile gelecekle ilgili olumlu beklenti puanları arasında orta düzey negatif bir ilişki bulunmaktadır. Üstün zekâlı öğrencilerin gelecekle ilgili yazdıkları kompozisyonun içerik analizinde çok yüksek oranda geleceğe yönelik olumlu ifadelerin yer aldığı bulunmuştur. Bu sonuç yapılan nicel ölçümleri destekler niteliktedir.

Araştırmanın hem nicel hem nitel analizlerine göre üstün zekâlı öğrencilerin geleceğe yönelimlerinin olumlu olduğu ve umutsuz olmadıkları söylenebilir. Genel popülasyonla ilgili yapılan araştırma sonuçları ile bu araştırmanın sonuçlarına bakıldığında üstün zekâlı öğrencilerin umutsuzluk düzeyinin çok düşük olduğu görülebilir. Diğer bir ifadeyle üstün zekâlı çocukların geleceğe yönelik umutları yüksektir. Üstün zekâlı öğrencilerin akademik benlik kavramlarının ve içsel motivasyonlarının yüksek olması bu sonuçların ortaya çıkmasına yol açtığı düşünülmektedir. Fakat üstün zekalıların kendilerini çaresiz hissetme (Tallent-Runnels ve Yarbrough, 1992), mükemmeliyetçilik (Webb, ve diğ., 2007) ve hayal kırıklığı yaşama (Roeper, 1988) riskleri de göz önüne alınarak yapılacak eğitim ve rehberlik programlarında bu türlü risklere de dikkat edilmesi gerektiği düşünülmektedir.

Araştırma üstün zekâlılara özel sınıfa devam eden öğrencilere yönelik yapılmıştır. Bunun yanında üstün zekâlılara özel bir programa devam etmeyen üstün zekâlı öğrencilerin geleceğe yönelik beklenti umutlarının da incelenmesi yararlı olacaktır. Ayrıca yaş, cinsiyet, sosyoekonomik durum ve kültürel çeşitlilik gibi faktörleri de dikkate alınarak daha geniş üstün yetenekliler örnekleminde yapılacak çalışmalar alana katkı sağlayacaktır.

INTRODUCTION

Educational researchers have stressed the importance of time perspective as a factor related to learning, academic achievement and education (Husman & Lens, 1999; Phalet, Andriessen & Lens, 2004). Human behaviors are determined by both past experiences and future expectations (Adler, 1994). Thoughts and dreams about their future goals, hopes, expectations, and anxieties are defined as future orientation (Nurmi, 1991; Seginer, 1988). Future orientation is considered as a motivating factor and influencing present behavior (Honora, 2002). Having aims, plans, and expectations about the future plays a vital role in motivation (Nuttin & Lens, 1985). These are critical in the growth of adolescents who are confronting some future life options (Allen, Philliber, Herrling &, Kuperminc, 1997) Researches showed that future orientation contributes school achievement through improving long-term goal setting and persistence (Nurmi, Poole, & Kalakoski, 1994; Nuttin, & Lens, 1985). Many factors such as interests, values, beliefs, personality, skills, cognitive factors, historical time, and culture, social and physical environment influence the future orientation (Erikson, 1994; Nurmi 2004; Nurmi, Poole, & Kalakoski, 1994).

Individuals who have positive future orientation are relatively optimistic towards the future and look at the future with hope (MacLeod & Byrne, 1996). Hope is considered as a positive expectation in achieving a future goal (Seber, 1991). Hope includes the will and the ways to attain the goals (Snyder, Irving, & Anderson, 1991). Hopelessness leads to an increase in pessimism towards life and future (Lavender & Watkins, 2004) and to a decrease or disappearance in optimism (Kashan et al., 1991). Carver and Scheier (1999) have stated that a growing body of literature supports the idea that expectations of favorable outcomes have an important effect on how people react to problems and difficulties. According to Torrance (1993), the best predictor of future creative achievement is the view of the future and the passion developed in the childhood. Future goals affect children's interest and approach to task accomplishment (Hidi & Harackiewicz, 2000). Perrone (1997) points out that gifted students often get pleasure from pursuing a goal. Gifted entrepreneurs have a positive vision of the future and have confidence in their ability to change the world by succeeding in their goals (Shavinina, 2009). According to Perrone, (1997) gifted children have the ability to create their own future as a career Kelly (1992) found that gifted students perceived fewer career obstacles than other students. Tallent-Runnels and Yarbrough (1992) found that gifted children participating in a future problem-solving program stated more concern about the future than children who did not participate. Also, these children stated that they thought having more control over the future than non-participating peers. Gifted children have been found passionate, in particular, about issues that they are interested (Lovecky, 1993). Gifted learners have said that they love thinking about the future, and this love increases as they become older (Torrance, 1978). According to Perry (2002), a child who learns quickly and can also learn from minimal experiences tends to rely easily upon his/her own experience and capacity to imagine a happy and safe future. Due to the fact that gifted children take more initiative about the future, outcomes of what they did could be greater (Lovecky, 1992). They consider possible, probable, and preferable futures (Passow, 1988). The issues mentioned above may contribute to future hopes and expectations of gifted students.

However, some characteristics that gifted children have may affect negatively their view of the future. For example; gifted students are more interested in global issues than their peers and sometimes feel helpless when they cannot do anything about these issues (Tallent-Runnels & Yarbrough, 1992). Some gifted children set unrealistic and impossible goals because they believe that perfection is the only acceptable performance level (Webb, et al., 2007). Therefore, they can become frustrated when their attempts to follow their perfectionist beliefs are not accomplished (Roeper, 1988). George and Gallagher (1973) compared optimistic and pessimistic attitudes of gifted and non-gifted students towards the future. They found that gifted students were significantly more pessimistic towards the future than non-gifted students. In addition, they analyzed students' attitudes when faced with future problems. According to the analysis, the gifted students were significantly more solution-oriented than non-gifted students (George & Scheft, 1998). In 1998, a similar study revealed that both gifted and non-gifted groups were becoming increasingly more negative towards the future, and the pessimism of gifted students has dramatically increased. Also, gifted students were less solution-oriented and saw a plenty of problems but few solutions (George & Scheft, 1998). Many gifted adolescents fell into discouragement, hopelessness, insecurity, and a sense of meaninglessness (Kline & Short, 1991; Kerr & Cohn, 2001). In addition, gifted students may worry about the future because of their sensitivity to

world problems (Passow, 1988). Awareness of being different and being morally more sensitive than others (Silverman, 1994) can affect their future expectations. Landua (1976) found that gifted children demonstrated more concern and pessimism about future. Callahan, Cunnigham, and Plucker (1994) found that gifted girls had unreal expectations of the future and a lack of planning for the future. But Schuler (1999) found that gifted girls had specific educational goals for their future, and almost all had definite career goals and the future was very important to them. As a result, because of their some characteristics, future hope and expectation of gifted children may be positive or negative that may affect their life satisfaction and academic achievement.

One of the important goals of education is to teach students how to develop a positive attitude toward the future and increase their life satisfaction on the way to becoming qualified individuals and professionals. In this study, future hopes and expectations of gifted students will be examined. Because the future image of students can affect their current success (Singer, 1974). So examining gifted students' future hopes and expectations is also important for measures to be taken on behalf of today's success. Analysis of future hopes and expectations of gifted students who have a potential to be a leader for change and societies will also contribute to their educational and guidance services. Also, school environments are important for the future expectations of individuals (Kızmaz and Bilgin, 2010). The results of the study can shed light on the regulation of the proper school environment for gifted students. In addition, teaching them to think appropriately about the future is an important task (Hibel, 1991). Therefore, to accomplish this important task firstly their future expectation and hope level should be analyzed. Although there are some studies (Ceylan, et al., 2003; Eryılmaz, 2011; Güler, 2004; Imamoglu & Edwards, 2007) about hope and future orientation with the general population in Turkey, the lack of research on the future view of gifted students increases the significance of this study.

The aim of the present study was to scrutinize hope and future expectations of gifted children who are often seen as "the hope of the future" (Wilms, 1986). The following questions were investigated for this purpose:

What is the level of the hopelessness of gifted students?
What is the level of gifted students' positive expectations for the future?
Is there a correlation between hopelessness and future expectation?
How did gifted students express their future expectations?

METHOD

A mixed method was used in the research. A mixed-methods research is a procedure for collecting, analyzing, and mixing both quantitative and qualitative research and methods in a single study to understand a research problem (Creswell, 2003). Application of mixed methods can strengthen the evaluation data and allow for more detailed understandings of a topic (Greene, Kreider, & Mayer, 2005). In this study, the quantitative descriptive model was applied to analyze hopelessness and future expectations of gifted students. In the qualitative part of the research, content analysis was conducted to gifted students' writings about future expectations.

Participants

The participants were a convenience sample of 65 (41 boys and 24 girls) gifted middle school students (attending a program for gifted students in a private school. Participants ranged in age from 11 to 15 years (M = 12.5, SD = 1.4). The studied gifted group composed of 5th (n = 18), 6th (n = 17), 7th (n = 15) and 8th (n = 15) graders. The gifted education program in the private school was based on special class for gifted students. In other words, gifted students who were selected for the program attended a separate class that only composed of students identified as gifted. In this class, a differentiated and enriched educational program has been provided to the gifted students. Students are admitted into the program on the basis of criteria including group mental abilities test, individual intelligence test, and one-week orientation program. First of all candidate students were conducted group Primary Mental Abilities Test 7-11 (PMA 7-11). Students who got the necessary score from group test were taken to individual intelligence test (WISC-R). Students whose individual intelligence test scores were 130 IQ and higher have participated to the one-week orientation program. After orientation program, gifted program commission selected 20 gifted students for this special class.

Instruments

The instruments used in this study include two scales and writing a composition. Instruments were described in detail in the following:

Beck Hopelessness Scale (BHS): It was developed by Beck and his colleagues (1974) to measure the extent of the pessimism of an individual about the future. This self-report inventory consisted of 20 items related to feelings and ideas about the future and scores calculated as 0-1.The questions are answered as "yes" or "no". There are items like "My future seems dark to me" and "I have great faith in the future". The answer 'yes' is equal to 1 point in 11 questions and answer 'no' is equal to 1 point in 9 questions. Scale scores can range from 0 to 20. The higher the score gets, the more hopeless the individual is. Scores provide a measure of the severity of self-reported hopelessness: 0–3 none or minimal, 4–8 mild, 9–14 moderate, and 15–20 severe (Beck and Steer, 1988 cited in Duman, Taşğın, & Özdağ, 2009). It was developed for use in adults and adolescents. The scale has three dimensions, which are Hope about the future, the loss of motivation and expectations about the future (Beck, et al., 1974). Firstly, Seber, et al., (1993) adapted the scale into Turkish version. They found internal consistency coefficient as .85 and test-retest reliability coefficient as .74. Also, they revealed a significant relationship between BHS and Beck Depression Scale and Rosenberg Self-Esteem Scale as a support of the validity of the scale.

The reliability and validity study of the scale was subsequently carried out by Durak (1994), its internal consistency coefficient was found to be .85, its item-total correlations were between .31 and .67, and its split-half reliability was .85. In this study, the alpha coefficient was found as .92.

The Positive Future Expectation Scale (PFES): This five-item scale developed by İmamoglu (2001) aims to measure the positive expectations regarding the subjects' individual futures. Items were like "I am an optimist about my personal future", and "I believe I will reach my goals at the end". None of the items was scored in the reverse direction. Cronbach's alpha of the scale was found to be .85 (İmamoglu, 2001) and .92 (İmamoglu, 2005) from previous studies. Test-retest reliability coefficient score was found .72 (İmamoglu & Güler-Edwards, 2007). Eryılmaz (2011) used this scale in an adolescent sample and found out that this five-item scale was collected in one factor and the explained variance of this factor was 65.9 %. In this study, the Cronbach's alpha for the scale was .91.

Composition: Gifted students were asked to write a composition about their future expectations, goals, and thoughts in the sample. This writing enabled the student to freely express them about future. Content validation of the composition question was provided by the experts in the field of gifted education.

Data Collection and Analysis

First of all, gifted students were given BHS and then PFES. After a brief explanation about the scales, participants were asked to answer all the questions sincerely. After scales were conducted, students wrote their composition about future. Before the composition, a brief explanation of what they write was provided to the students as "I want you to write about your future goals, future views, and plans as you wish. You can write as long as you wish". The reason for asking them to write a composition about future is to express them as they wish about the future. Namely, to minimize the limitation of using a quantitative scale, participants were asked to write a composition. Scales and writing applications took about 40-50 minutes. All applications were made by the researcher.

In this study, the qualitative and quantitative data were analyzed sequentially. In the analysis of quantitative data, descriptive statistical techniques such as mean and standard deviation were used. In addition, Pearson's correlation coefficient was carried out as a means to estimate the relationship between two scales. In the qualitative dimension of the research, analysis of the data obtained from students' handwritten compositions was made by using content analysis method. Content analysis is a scientific approach that researches social reality by means of objective and systematic classification, quantification and inference of messages in oral, written and other materials in terms of their meanings or linguistics (Tavşancıl & Aslan, 2001). The fundamental goal of the content analysis is to show concepts and relationships that can explain the collected data (Miles & Huberman, 1994). The sentence has been chosen as the unit of analysis while analyzing compositions in the research. The content analysis starts with the coding of data. From these codes, themes and categories have been created. Also in the process of data analysis, the similarities of identified codes are determined and these codes are combined with each other. In addition, to improve the internal validity of the study, quotations from students' opinions are directly given. Students were given the pseudonyms like S1, S2, S3… For the

inter-judge reliability student writings were examined by the researcher and two experts from gifted education. The strength of inter-judge reliability was evaluated with formula or numerical indices based on the level of agreement among them. The formula indicated by Miles and Haberman (1994) was used to calculate the concordance coefficient as follows: P (concordance coefficient) = [Na (number of judge agreements)/Na(number of judge agreements) + Nd (number of judge disagreements)]x100. After the calculation, concordance coefficient was found .86 and this was considered acceptable. It was used as frequency analysis for categories and subcategories. Frequency analysis is a type of content analysis that reveals the quantitative frequency of units (Tavşancıl & Aslan, 2001).

RESULTS

While writing mixed-method research findings obtained from the data, researchers give firstly quantitative results, and then present the findings from qualitative findings. So in this study, firstly quantitative results and then qualitative results will be presented. Hopelessness which is the opposite of hopefulness is considered as negative expectations about the future (Beck et. al., 1974). So gifted students' hopelessness level was analyzed with Beck Hopelessness Scale and results were given in Table 1.

Table 1. The Descriptive Statistics Relating to Beck Hopelessness Scale and Subscales

Scales	N	Min	Max.	$\overline{x}$	SD
Hope	65	0	4	1,06	1,17
Expectation about Future	65	0	7	,78	1,53
Loss of Motivation	65	0	7	1,51	1,79
Total	65	0	17	3,35	3,84

It is seen in Table 1 that hopelessness total score mean of gifted students was found as 3.35 (SS= 3.84) When we look at subscales, Hope subscale's mean was 1.06±1.17; Expectation about Future Subscale's mean was.78±1.53 and loss of motivation subscale's mean was 1.51±1.79. Gifted students were conducted to positive future expectation scale to learn how positive future expectations they have, and results are shown in Table 2.

Table 2. The Descriptive Statistics Relating to Positive Future Expectation Scale

Scale	N	Min	Max.	$\overline{x}$	SD
PFES	65	10	25	20,06	4,264

It was calculated that gifted students' mean score obtained from positive future expectation scale was 20.06± 4.26. The highest score that can be obtained from the scale was 25 and the higher score means more positive future expectation. While Beck Hopelessness Scale was about a negative expectation of the future, Positive Future Expectation Scale was about the positive expectations of the future. So, the correlation between these scales was calculated and shown in Table 3.

Table 3. Pearson's Correlation Coefficients between PFES and BHS and subscales

	N	1	2	3	4
PFES(1)	65	1			
BHS (2)	65	-.454**	1		
BHS-Fut.(3)	65	-.349**	.865**	1	
BHS-Mot.(4)	65	-.441**	.904**	.669**	1
BHS- Hope(5)	65	-.358**	.765**	.503**	.557**

Note: PFES: Positive Future Expectation Scale, BHS-Fut.: Beck Hopelessness Scale Future Expectation subscale, BHS-Mot.: Beck Hopelessness Scale Loss of Motivation subscale BHS- Hope: Beck Hopelessness Scale Hope, ** $p < .01$

There were significantly negative relationships between two scales' total and sub-scores in Table 3. This means that the less hopelessness, the more positive future expectations. As described previously, gifted students were asked to write about their expectations of the future to support quantitative data. Utterances of students about future were analyzed with content analysis of their writings. Content analysis was made at the sentence level. It was found that 268 statements were about their future

expectation and hope. Firstly, these 268 statements were analyzed in terms of negative and positive regarding future and shown in Table 4.

Table 4. Distribution of Gifted Students' Statements about Future

Sentences	n	%
Positive Sentences about Future	250	93.2
Negative Sentences about Future	18	6.8
Total	268	100

According to the table, while expressing their expectations of the future, it was found that 250 statements (93.2%) were identified as positive about future but only 18 statements (6.8%) were negative. Gifted students' positive expectations of the future seem very high in their writings. Then, the positive statements of the future of gifted students were studied in detail and these positive expectations were categorized according to themes. Percentages and frequencies of the themes of positive statements are seen in the following table.

Table 5. Themes of Gifted Students' Positive Statements about Future

Positive Themes	n	%
Setting future goals	160	64
Contribution to humanity	18	7.2
Self-confidence about their future	17	6.8
Challenging future goals	16	6.4
Optimism	14	5.6
Being famous	13	5.2
Happiness	6	2.4
Pursuing their interests in the future	6	2.4
Total	250	100

According to the table, most of the 250 positive statements for the future are about setting future goals (64%). Then, other themes are respectively about contribution to humanity (7.2%) self-confidence about their future (6.8%), challenging future goals (6.4 %). Also being famous (5.2%), being happy in the future (2.4%) and pursuing their interests in the future are listed among gifted students' positive statements of future. Examples of themes are given as following.

Examples of setting future goals:
S13: I am going to be a public prosecutor after completing my education. For this goal, I am informed that law department in university and Turkish-Math. Classes in high school are necessary. So, I should get a good score in the university entrance exam.
S7: I want to be an endocrine doctor when I finished the university.
S24: I will be a good mother.
S6: I want a five-flat home and a large garden.
S2: I want to have a car in the future.

Examples of contribution to humanity:
S3: I will go fishing in nature and help smart children.
S54: I will work in Hakkari and Şırnak and I'll offer education to children by risking my life.
S24: I will work for my country and I want to equip our army with the best weapons and armament.
S49: I want to be someone who is extremely helpful to humanity.

Examples of self-confidence about their future:
S45: If I really want them, I think I can reach my goals easily.
S37: I believe in my talents about what I said.
S7: When I start to study, I know that I will face some difficulties but, I think, I can overcome them by perseverance and I believe in myself on this issue.

Examples of setting challenging goals for the future:
S4: I want to graduate from high school as valedictorian.
S34: I want to build the world's most advanced hospital.
S19: First of all, I will finish secondary school with honor degree such as ranking as the first, and after that I want to win the best high school like Istanbul High School with a good exam score.

Examples of looking optimistic to the future:
S27: I do not think that there is any obstacle ahead of me.
S13: I'm looking at my future hopefully and I think my future will be better than today.
S32: To build my future, my opportunities are more than impossibilities.

Examples of being famous:
S6: I want to be spoken about all over the Turkey.
S42: I will be a well-known scientist in the world.
S51: I want to be a very famous and popular doctor.

Examples of being happy in the future:
S7: I will be an ordinary human being but I want to be happy.
S41: I want to work happily in a good department in a private hospital. Anyway, who does not want to be happy?
S39: I would like a happy life, with everything I have.

Examples of pursuing their interests in the future:
S50: I will play piano and play basketball as a hobby.
S28: I will engage in piano, ice skating and painting all at the same time.
S56: After being a doctor, I will open a fashion house and then write some books.

After analyzing the positive statement for the future of gifted students, negative sentences were examined in detail and these few negative statements are divided into 3 themes. These themes were uncertainty about future, barriers to the future and worry about the future. Percentages and frequencies of the themes of negative statements are seen in the following table.

Table 6. Themes of Gifted Students' Negative Statements about Future

Negative Themes	n	%
Uncertainty about the future	7	38.9
Barriers to the future	7	38.9
Worry about the future	4	22.2
Total	18	100

As seen Table 6, gifted students stated their negative future views as uncertainty, barriers, and worries about the future. Students equally expressed uncertainty about the future (7 statements) and barriers about the future (7 statements) in their writings. Only 4 statements express their worries about the future. Examples of themes of students' negative statements for the future are given below;

Examples of uncertainty for the future:
S18: I cannot visualize my future in my mind.
S43: I don't have any plan about future yet. Specifically, I have no idea about which high school I will attend and which field I will select for the university.

Examples of barriers for the future:
S3: There is no easy way to future and I think there are more barriers on this way.
S58: While determining my future, the most important obstacle for me is being a female.
S17: One of my obstacles is my father. Always he talks about my failures but he does not care about my success.

Examples of worries for the future:
S58: I'm worried about mistakes, so I have no expectations about the future.
S18: I do not know if I can fulfill my future plans. That's one of the biggest anxieties about the future. Others are admitted to a good high school and then a good university.

DISCUSSION and CONCLUSIONS

The future view is important for present and future achievement in one's life. Therefore, future hope and expectations of gifted students were studied in this research. In this context; hopelessness level, positive future expectation level, and writings about future expectation were analyzed
Firstly, hopelessness level of gifted students was examined to uncover their future expectation, due to the fact that hopelessness is the level of pessimism about the future (O'Conner, Cennery, & Cheyne, 2000). It can be expected that people who are optimistic about the future do not give up easily when faced with challenges and have more constructive effort to achieve the objectives (Snyder et. al., 1991). According to score intervals determined by Beck and Steer (1988), the hopelessness level of gifted children (3.35±3.84) showed no hopelessness. It is possible to say that gifted children are not hopeless about the future. Taner Derman (2013) examined the hopelessness level of 179 students (10-11 years) from the general population with the same scale and found that girls' mean score was 4.34 and boys' mean score was 5.87. So, gifted students seem to have lower hopelessness level than the general population. Gifted children's initiative attitude towards the future (Lovecky, 1992) and their passion (Silverman, 1993) may affect their hopelessness negatively. Also, their inclination for pursuing a goal may increase their hope for the future.
Secondly, gifted students' mean score of positive future expectation scale was calculated as 20.06± 4.26. This score can be interpreted as a positive future expectation of gifted students was high. By using the same scale with 233 (14-17 ages) students from the general population, Eryılmaz (2011) found the mean score of PFES as 19.54±3.39. Academic self-concept influences students' future preferences (Ahmavaara & Houston 2007; Koumi, 2000). If a student relies on his or her academic abilities, his or her future plans will be affected positively. In addition, many studies (Ludtke, et al., 2005; Pajares & Graham, 1999; Pyryt & Mendaglio, 1994) revealed that gifted students' academic self-concept tends to be higher than their peers (Wilson, et al., 2014). In this case, high academic self-concept of gifted students may influence their future expectation positively in the study. Also, studies showed a correlation between future views and academic success (Honora, 2002; Hortsmanshof & Zimitat, 2007). For instance, Cartron-Guerin & Levy (1980) found that academic achievement was positively associated with positive thinking about the future among adolescents. Also, in a group of academically talented adolescents, it was seen that future positive attitudes had significant positive relationships with academic achievement (Mello & Worrell, 2006). Therefore, gifted students' good academic achievement may have a positive impact on their future expectations in the study. Additionally, because of their higher levels of cognitive development, gifted students, even at a younger age, can foresee future in a further way than their peers can do (Lens & Rand, 2000; Morisano & Shore, 2010). Another factor that may have an effect on their positive future expectation may be their intrinsic motivation. Because Hortsmanshof and Zimitat (2007) argued that future-oriented students are more intrinsically motivated. Furthermore, gifted students scored more intrinsically than other students on measures of motivation in many research (Csikszentmihalyi, Rathunde, & Whalen, 1993; Gottfried & Gottfried 1996; Olszewski-Kubilius, Kulieke, & Krasney, 1988).
Correlation between hopelessness scale and positive future expectations scale was found as r=-.45. Correlation coefficient values between 0.30 – 0.70 indicate a medium correlation (Büyüköztürk, 2009). Therefore, there is a moderate negative correlation between hopelessness and positive future expectations. Other researchers also revealed a negative relationship between these two constructs (Hunter & O'Connor, 2003; O'Connor et.al, 2004). Hopelessness includes expecting negative situations in the future rather than positive outcomes (Abramson et.al., 1989). Furthermore, some research (Güler 2004; İmamoglu & Edwards, 2007; Neblett & Cortina, 2006; Seginer, 2008) showed that optimism had a positive effect on students' future orientation. As a result, any decrease in the level of hopelessness may lead to an increase in positive future expectation in the study.
Finally, a very high rate of positive future expectation (93.6%) was found in gifted students' writings after content analysis of their compositions. These results support two scale results in the study. Future

expectations of adolescents often include plans like finishing school, succeeding in a job, having a title, finding a lover, marrying and having children (Nurmi, 1991; Şimşek, 2012). In the study, gifted students wrote their positive expectations about the future with themes containing setting goals for the future, contribution to humanity self-confidence about future, setting challenging goals, looking optimistic towards the future, being famous, being happy in the future and following their interests in the future. Moon and Feldhusen (1993) found that gifted students had medium or high level educational and career goals in the study including 23 gifted students who participated in enrichment programs. Studies indicated that future perspective was associated with various career-related factors such as student motivation, career goals, career choices (Zimbardo & Boyd, 1999). In this research, gifted students stated achievement motivation, future career goals, and setting challenging goals in their writings. Similarly, Lancaster (2012) studied 4 gifted adolescents based on semi-structured interviews. Each participant stated a prestigious college he/she planned to enter, indicating that he/she maintained high academic future goals. All of these themes about positive future expectation also provide more evidence for the future view of gifted students.

Although there was not much, gifted students stated some negative themes about future in their writings such as uncertainty, barriers and worries about the future. They are more interested in global problems than peers and sometimes feel helpless to do anything about these problems (Tallent-Runnels & Mullen, 2004; Tallent-Runnels & Yarbrough, 1992). Therefore, this despair may lead to a negative expectation for the future. Silverman (1994) stated that many studies have shown the gifted to have stronger overexcitabilities than peers. These overexcitabilities may lead to negative statements. Passow, (1988) claimed that gifted students worry about the future, because of their sensitivity to world problems.

According to the research, it is concluded that gifted students have positive expectations and were not hopeless about future. Results of both hopeless and future expectation scales indicated that gifted students had a positive view towards the future. Also qualitative analysis of their compositions supported the results of the scales. Gifted students stated more positive expectations for the future in their writings. These characteristics can make stronger them to successfully manage change (Carroll, 1991). Therefore, this positive future expectation among gifted students should be supported in school settings. Therefore, educators and experts in education are supposed to take into consideration future view and hope of gifted students who are hope of our future. Gifted students are viewed as a future leader because of their cognitive and leadership skills (Sisk & Vidergor, 2013). So their expectations and hope about future are important. This study showed their positive expectations but whether or not these expectations and hope will continue to adulthood is not certain. Educators should support their positive expectations about future. Educational programs that focus on the past and the needs of the present should be replaced by curricula that are structured so as to be in conformity with and meet the expectations of the future.

Although this study provided important insights about future view among gifted students, there were some limitations to note in the study. Firstly, the small sample size (n = 65) limits the generalizability of the findings. It is possible, that with a larger and more diverse sample, results would be more significant. Additionally, causational research about future expectations of the gifted students may provide an additional contribution to the field to understand future view in detailed among gifted students. However, studies suggest other factors that affect future orientation such as age, gender, socioeconomic status and cultural diversity. Studies that take these factors into consideration in a larger sample of gifted students can contribute to the field. The gifted students attended a gifted program in the research. This provision may affect their future expectation. But how do other gifted students who did not attend any special programs think about future? This question should be addressed with studies that include other gifted students.

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Seventh Grade Students' Mathematical Difficulties in Force and Motion Unit

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ABSTRACT Integration of science and mathematics as well as with other disciplines is overarching goal of science education. In spite of its importance, teachers have concerns about mathematical difficulties that their students encounter during their teaching. One of the most common subjects that students have mathematical difficulties was reported as physics. With this regard, the present study is aimed to investigate seventh grade students' mathematical errors in a physics related subject, specifically force and motion unit. We collected data from 129 seventh grade middle school students which were chosen conveniently throughout an open-ended questionnaire. The findings revealed that the students encountered difficulties in ratio and proportion and conversion of units, topics as well as ordering numbers while answering the questions in this unit. Implication for science courses was discussed.

Keywords *Force and motion, mathematical difficulties, integration, science, mathematics*

Yedinci Sınıf Öğrencilerinin Kuvvet ve Hareket Ünitesi'nde Yaşadıkları Matematiksel Zorluklar

ÖZ Fen-matematik disiplinlerinin entegrasyonu, fen eğitiminin önemli amaçlarından biridir. Fen-matematik entegrasyonun önemi vurgulanmasına rağmen, fen bilimleri öğretmenleri derslerinde sıklıkla matematiksel zorluklarla karşılaştıklarını belirtmektedir. Öğrencilerin matematik temelli zorluklar yaşadığı konulardan biri de fizik konularıdır. Buradan yola çıkılarak bu araştırmada, yedinci sınıf öğrencilerinin bir fizik konusu olan Kuvvet ve Hareket Ünitesinde yaşadıkları matematik temelli sorunların belirlenmesi amaçlanmıştır. Veriler, uygun örneklem yöntemi ile seçilmiş yedinci sınıf öğrencilerinden (N=129) açık uçlu sorular yardımıyla toplanmıştır. Bulgular, bu ünitede öğrencilerin oran-orantı ve birim çevirme gibi matematiksel zorluklar yaşadığını ortaya koymuştur. Bulgulara dayanılarak fen dersleri için çeşitli öneriler getirilmiştir.

Anahtar Kelimeler *Kuvvet ve hareket, matematiksel zorluklar, entegrasyon, fen, matematik*

GENİŞLETİLMİŞ ÖZET

Fen ve matematik alanlarının diğer alanlarla ilişkilendirilmesinin gerekliliği, bu tür ilişkilendirmelerin öğrencilerin kavram öğrenmelerini geliştirdiği yönünde araştırma sonuçları ile desteklenmiştir (Czerniak, 2007; Roehrig, Moore, Wang & Park, 2012; Wang, 2005). Çalışmaların ortak bulgusu olarak, fen ve matematik entegrasyonunun öğrencilerin başarısını (Hurley, 2001; Kıray ve Kaptan, 2012), motivasyon ve problem çözme yeteneklerini etkilediği (Offer ve Vasquez-Mireless, 1999; Venville ve diğerleri, 2004) rapor edilmiştir. Çetin ve arkadaşları (2015) öğrencilerin fen ve matematik başarıları arasında güçlü bir ilişki olduğu sonucuna varmışlardır. Farklı alanların entegrasyonunun öneminin artması, bu alanda yapılan çalışmaların sayısını etkilemiştir (Berlin ve White, 2005). Bu önem, ayrıca öğretmenler tarafından da sıklıkla dile getirilmiştir (Akinci, Uzun, & Kisoglu, 2015; Baskan, Alev, Karal, 2010; Frykholm & Glasson, 2005; Karaer, 2006; Kiray, Gok, Caliskan, & Kaptan, 2008; Koirala & Bowman, 2003; Riordain, Johnston, & Walshe, 2015). Başkan ve arkadaşlarının (2010) yaptıkları çalışmada, öğretmenlerin fen ve matematik entegrasyonunun öneminin farkında oldukları ancak bu entegrasyonu nasıl gerçekleştireceklerinin yeterince farkında olmadıkları vurgulanmıştır. Yine öğretmenler, fen kavramlarını öğretirken matematiksel zorluklar yaşadıklarını dile getirmişlerdir (Akıncı ve ark. 2015, Karaer, 2006, Venville ve ark. 2004). Çalışmalar ayrıca, öğrencilerin de fen kavramlarını öğrenirken matematiksel zorluklar yaşadıklarını vurgulamaktadır (e.g., Akatugba & Wallece, 1999; Basson, 2002; Bütüner ve Uzun, 2011; Corlu & Corlu, 2012; Howe, Nunes, Bryant, 2010a; 2010b; Roth ve Bowen, 1999). İlgili alan yazında rapor edilen zorluklar; birim çevirme (Kocaoğlu ve Yenilmez, 2010), oran-orantı (Dole ve Shield,2008), grafik okuma ve anlama (Capraro ve ark. 2005; Demirci & Uyanik, 2009; Roth ve Bowen, 1999), doğru-ters orantı (Akatugba & Walelce, 1999; Howe ve ark. 2010a, 2010b; Lamon, 2007) ve kesirli sayılardır (Lamon, 2007).

Matematiğin fizik derslerindeki rolü pek çok çalışmada vurgulanmıştır (Fumer ve Kumar, 2007; Li ve ark. 2002; Orton ve Roper, 2000). Yer bilimleri, biyoloji ve kimya dersleri ile kıyaslandığında matematiksel ifadeler, fizik konularının anlaşılmasında önemli rol oynamaktadır (Li ve ark. 2002). Türkiye'de yapılan çalışmalarda, fizik kavramlarının anlaşılmasında matematiksel işlemlerin önemi (Aycan ve Yumuşak, 2003) vurgulanırken, Şahin ve Yağbasan (2012) öğrencilerin fizik konularındaki başarısızlığının nedeni olarak matematik konularındaki yetersizliği olduğunu ifade etmiştir. Öğrencilerin fizik konularında yaşadıkları matematiksel zorlukların belirlenmesi, bu zorlukların giderilmesi açısından önemlidir. Buradan yola çıkılarak bu araştırmada yedinci sınıf öğrencilerinin kuvvet ve hareket ünitesinde yaşadıkları matematiksel zorlukların belirlenmesi amaçlanmıştır.

Araştırma nitel araştırma yöntemlerinden olan doküman analizi yöntemi kullanılarak gerçekleştirilmiştir (Yıldırım ve Şimşek, 2008). Öğrencilerin yaşadıkları matematiksel zorlukların belirlenmesi amacıyla araştırmacılar tarafından hazırlanan sorular kullanılmıştır. Öğrencilerden elde edilen cevaplar kullanılarak sıklık tabloları oluşturulmuş ve her bir soru ayrıca yorumlanmıştır. Araştırmaya 2012-2013 yılında devlet okulunda öğrenim görmekte olan ve uygun örneklem yöntemiyle seçilmiş 129 yedinci sınıf öğrencisi katılmıştır.

Araştırmada kullanılan açık uçlu soruların oluşturulmasında var olan çalışmalardan (Bütüner & Uzun, 2011; Yazarlar, 2014) ve fen bilimleri müfredatındaki kuvvet ve hareket ünitesindeki kazanımlar yararlanılmıştır. Daha sonra fen ve matematik alanında doktora yapan uzmanlar ve fen bilimleri öğretmenleri tarafından incelenen sorulara son hali verilerek uygulanmıştır.

Araştırmanın geçerliliği; meslektaş teyidi, uzman incelemesi ve nitel sonuçların nicelleştirilmesi gibi (Maxwell, 1998) yöntemlerden yararlanılarak gerçekleştirilmiştir. Araştırmanın güvenilirliği ise araştırmacıların rolünün, katılımcı özelliklerinin, veri toplama yöntemlerinin ve veri analizlerinin nasıl yapıldığının açıklanması (LeCompte ve Goetz, 1982) ile gerçekleştirilmiştir.

Araştırmanın bulguları incelendiğinde, öğrencilerin önemli bir kısmının (%74) sorulardan aldıkları toplam puanın 50'nin altında olduğu ve katılan öğrencilerin hiç birinin sorulan soruların tamamına doğru olarak yanıt veremediği görülmüştür. Bu sonuçlar, öğrencilerin sorulara cevap vermede zorluklar yaşadığını göstermiştir. Her bir sorunun daha detaylı olarak incelenmesi ile öğrencilerin yaşadıkları matematiksel zorluklar belirlenmeye çalışılmıştır. Öğrencilerin verdikleri cevaplar incelendiğinde, öğrencilerin önemli bir kısmının (%74) çizgi grafiğini yorumlayabildikleri**,** ancak çizgi grafiğini okuyup doğru orantı kullanarak cevap vermeleri gerekli olduğunda, bu oranın %27'ye düştüğü görülmüştür. Öğrencilerin neredeyse tamamına yakınının (%92) ise birim çevirmeyi yapamadıkları görülmüştür. İncelenen diğer sorularda ise öğrencilerin yarıya yakınının (%50) doğru şekilde iş formülünü

uygulayamadıkları, %74'ünün ise potansiyel enerjilerine göre cisimleri sıralamada zorlandıkları görülmüştür. Ayrıca öğrencilerin dişli sorularına cevap verirken ters orantıyı kullanmada zorluklar yaşadıkları (%62 ve %84) görülmüştür.

Öğrencilerin kuvvet ve hareket ünitesinde yaşadıkları matematiksel zorluklar, ilgili alan yazında belirtilen matematiksel zorluklarla örtüşmektedir (Aycan ve Yumusak, 2003; Kararkuyu, 2008; Oon ve Subramaniam, 2011; Şahin ve Yağbasan, 201). Öğrencilerin çizgi grafiklerini yorumlamada yaşadıkları zorluklar (Capraro ve ark. 2005; Demirci ve Uyanik, 2009; Roth ve Bowen, 1999) tarafından da rapor edilmiştir. Ayrıca, Kocaoğlu ve Yenilmez (2010) kuvvet ve hareket ünitesinde yaşanan zorluklardan birinin birim çevirme olduğunu belirtmiştir. Bulgularımızdan biri olan öğrencilerin formülleri uygulaması ve doğru-ters orantı kavramlarında yaşanan zorluklar, yine ilgili alan yazında belirtilmiştir (Çorlu ve Çorlu, 2011; Karakuyu, 2008; Dole ve Shield, 2008; Howe ve ark. 2010a, 2010b; Lamon, 2007).

Sonuç olarak; formülleri uygulama, birim çevirme, grafik yorumlama, doğru-ters orantı gibi konularda öğrencilerin yaşadıkları matematiksel zorluklar, onların kuvvet ve hareket ünitesindeki düşük başarısının nedeni olabilir. Bu çalışma, neden-sonuç ilişkisine dayalı bir çalışma olmadığından, öğrencilerin kuvvet ve hareket ünitesinde gösterdikleri düşük başarının nedeninin matematiksel zorluklardan kaynaklandığını söyleyemeyiz. Fakat öğrencilerin matematiksel kavramları anlamadaki yetersizliklerinin onların fen kavramlarını anlamalarını etkilediğini söyleyebiliriz. Fen ve matematik konularını anlama ve başarı arasındaki ilişkilerin daha yakından incelenmesi için deneysel çalışmalara ve öğrencilerin fen ve matematik derslerindeki başarıları arasındaki ilişkinin daha derinlemesine incelenmesi için gözlem ve görüşmeler içeren nitel çalışmalara ihtiyaç vardır.

INTRODUCTION

The Principles and Standards for School Mathematics (National Council of Teachers of Mathematics [NCTM], 2000), the National Science Education Standards (National Research Council [NRC], 1996) and Next Generation Science Standards (NGSS Lead States, 2013) emphasized the connection between science and mathematics. This connection has also been highlighted in numerous studies (e.g. Basista & Mathews, 2002; Basson, 2002; Cetin, Corlu, Capraro, & Capraro, 2015; Frykholm & Glasson, 2005; Park-Rogers, Volkmann, Abell, 2007). Berlin and Lee (2005) reported that there had been an increase in the number of studies that focus on integration of science and mathematics in teaching and learning activities in their historical analysis during one hundred years (1901-2001). They, also, reported that there is an increasing emphasis on integrating science and mathematics education, particularly in teacher education programs.

Integration of disciplines such as science, mathematics and technology in teaching has long been aimed to deepen students' understanding by conceptualizing as well as broaden students' understanding (Czerniak, 2007; Roehrig, Moore, Wang & Park, 2012; Wang, 2005). As a common finding, studies indicated that integration of science and mathematics enhance students' achievement (e.g., Hurley, 2001; Kiray & Kaptan, 2012; Wang, 2005) as well as students' motivation and problem solving skills (Offer & Vasquez-Mireless, 1999) and helps students to make abstract concepts more concrete by using multiple representations (e.g. pictures, tables and graphs). Thus, they can develop deeper conceptual understanding in both disciplines (Park-Rogers et al., 2007). Integration of two disciplines **can also** enhance students' engagement in scientific tasks and problem solving skills (Venville, Rennie, & Wallace, 2004).

The importance of integration of science and mathematics has been also expressed by teachers as well as by pre-service teachers (Akinci, Uzun, & Kisoglu, 2015; Baskan, Alev, Karal, 2010; Frykholm & Glasson, 2005; Karaer, 2006; Kiray, Gok, Caliskan, & Kaptan, 2008; Koirala & Bowman, 2003; Riordain, Johnston, & Walshe, 2015). For instance, both science and mathematics teachers indicated that mathematics and science curricula have common principles and concepts. Furthermore, mathematics teachers stated that science should be related with mathematics for meaningful learning (Kiray et al. 2008). In another study, both physics and mathematics teachers appreciated the integration of science and mathematics but they were unable to explain how to connect these two disciplines (Baskan et al. 2010). On the other hand, they indicated the existence of problematic issues related to mathematics in their teaching (Akinci et al. 2015; Karaer, 2006; Venville et al., 2004).

Studies reported that students also struggle with mathematical difficulties (e.g., Basson, 2002; Bütüner & Uzun, 2011; Howe, Nunes, Bryant, 2010a; 2010b; Roth & Bowen, 1999). The reported difficulties were converting units (Kocaoglu & Yenilmez, 2010), ratio and proportion (Dole & Shield, 2008), understanding and interpreting the graphs (Capraro, Kulm, & Capraro, 2005; Demirci & Uyanik, 2009; Roth & Bowen, 1999), proportional concepts (Akatugba & Wallece, 1999; Howe et al. 2010a, 2010b; Lamon, 2007), computational fluency (Corlu, Capraro, & Corlu, 2011; Geary et al. 1999) and intensive quantities which combine direct and inverse proportion (Howe et al. 2010a, 2010b; Lamon, 2007) and fractions (Lamon, 2007).

The role of mathematics in science domains especially in physical science has been emphasized by Furner and Kumar (2007). The dependency of physics on mathematics was also referred in TIMMS data (Li, Shavelson, Kupermintz, & Ruiz-Primo, 2002). Algebra and data representation were reported as important predictors of physics domain when compared to other science domains including biology, earth science and chemistry (Li et al. 2002). Akatugba and Wallece (1999) indicated that physics concepts such as force, acceleration and pressure require a better understanding in mathematics including proportional reasoning.

On the other hand, students' mathematical difficulties in physics concepts have been well documented. For instance, Basson (2002) reported students' difficulties in mathematics were transferred to physics concepts such as force, velocity and acceleration. Some of the mathematical difficulties in physics unit (force and motion unit) were determined as drawing and interpreting graphs, ratio and proportion, and unit conversion problems (Bütüner & Uzun, 2011). Also intensive quantities such as density (directly proportional to mass, inversely proportional to volume) or speed (directly proportional to distance, inversely proportional to time) were reported as concepts that students had conceptual difficulties (Howe et al. 2010a, 2010b). In an earlier study, investigating students' difficulties in physics, Aycan and

Yumusak (2003) reported that students' difficulties in physics were caused by the abstract nature of subject and the inclusion of mathematical computational skills. The role of mathematical formulas and computations in physics were also reported as a barrier in understanding physics by Karakuyu (2008). Exploring senior secondary school physics students' use of proportional reasoning while solving physics tasks, Akatugba and Wallece (1996) reported that students' lack of awareness about proportional reasoning and the inconsistency between the concept of proportional reasoning and their everyday life experiences hindered their use of proportional reasoning while solving physics tasks. In a similar manner, Corlu and Corlu (2012) reported that candidate physics teachers had difficulties in applying formulas into physics problems. Investigating college students' difficulties in understanding physics, Sahin and Yagbasan (2012) reported that students' lack of understanding in physics concepts were related with their incompetence in mathematics. The abstract nature of physics was also emphasized by Oon and Subramaniam (2011). The authors emphasized that the competency in mathematics was associated with better understanding in physics concepts. Oktay Ciminli-Sülün and Sanalan (2014) also highlighted the role of mathematics in force and motion unit in their study. Specifically, they investigated science teachers' mathematics teaching skills while teaching velocity concept in sixth grade. They reported that the teachers perceived their skills in using mathematics while teaching velocity as sufficient. While science teachers perceived themselves as sufficient in using mathematics while teaching physics contexts such as velocity, other studies in both national and international contexts (e.g., Oon & Subramaniam, 2011; Sahin & Yagbasan, 2012) reported that students' difficulties in physics concepts are related with their lack of competence in mathematics.

Students' reported difficulties can be handled by integrating science and mathematics as Westbrook (1998) reported. This integration will also enhance students' concept learning in physics. Czerniak, Weber, Sandman, and Ahern (1999) emphasized the importance of research in understanding the actual benefits of integration. On the other hand, students' inadequacy with respect to skills and knowledge in mathematics has a negative effect on their understanding of physic concepts as Basson (2002) indicated. Since physics is a mathematically based subject as Orton and Roper (2000) stated, it is important to determine students' specific mathematical difficulties in this subject. In this regard, this study can help to reveal students' mathematical errors in interpreting graphs, ratio and proportion, unit conversion, and applying formulas in force and motion unit. For this purpose, we aimed to investigate seventh grade students' mathematical difficulties while dealing with the questions in force and motion unit.

METHOD

This study was designed by using qualitative methods, namely document analysis. Document analysis is a useful method to investigate intended phenomena or research questions by analyzing any kind of written documents such as textbooks, public records, curriculum directives, diaries, letters, exam paper (Merriam, 2009; Yildirim & Simsek, 2008). Using documents in a study can be better source of data when compared to interviews or observations because of providing participant-generated data on a specific subject (Merriam, 2009). However, using documents in a study could have limitations as well as strengths (Merriam, 2009). For instance, the documents that are not generated for research purposes could not be useful or understandable to the investigator (p.154). Thus, we preferred to use a researcher-generated document. We generated a questionnaire in line with our research question and examined participants' answers in these specifically generated questions. The documents generated by researchers also can be as a potential source for the purpose of investigation (Merriam, 2009). The document used in this study is *researcher-generated documents* as Merriam (2009) identified. We adopted this approach in order to determine students' mathematical errors in force and motion unit. Thus, we generated a questionnaire and sought information about students' common mathematical errors in force and motion unit by analyzing students' written answers about given questions.

Data collection and analysis is a primary concern of a qualitative study as LeCompte and Goetz (1982) indicated. Replicability of a study is not possible without precise identification and a good description of the strategies to collect data (Le Compte & Goetz, 1982). Thus, we conducted a literature review including previous conducted studies and objectives of science curriculum regarding force and motion unit and examined teachers' questions in this unit in a previous study (Cebesoy & Yeniterzi, 2014). Therefore, we were aware of the teachers' possible types of questions in this unit. We used researcher-generated questions to gather much detailed and rich information from students' answers.

After data collection procedure, we quantized our findings. Quantizing of qualitative data is a common interpretation technique known as counting method for determining and comparing the frequencies of codes and categorizes (Miles & Huberman, 1994). In order to examine students' mathematical errors, we constructed frequency tables regarding students' answers and interpreted each question.

Participants

A total of 129 seventh grade students in a public middle school voluntarily participated in the study. Because of financial and time constraints, the school was chosen conveniently. Data was collected throughout 2012-2013 spring semester.

Instruments

To examine the research question of the present study, an open-ended questionnaire which consisted of eight items regarding the objectives of force and motion unit was developed. These questions required mathematical knowledge to be solved. The questions were determined based on a) the science teachers' previous exam questions which were previously determined by Cebesoy & Yeniterzi (2014) and b) the reported mathematical difficulties in previous studies (e.g., Butuner & Uzun, 2011). In addition, the objectives of science curricula was taken into consideration during this process. After taking expert opinions from science and mathematics specialists and science teacher, the revised questionnaire was administrated to all students. The number of questions and the mathematical difficulties was presented in Table 1.

Table 1. Number of Questions with Respect to the Mathematical Difficulties

Related mathematical difficulty	Question numbers
Reading graph	1, 3
Direct proportion	2
Inverse proportion	7, 8
Ratio	2, 3
Unit conversion	3, 4
Using formulas	4, 5, 6
Ordering	5, 6

Validity

Validity in **a** qualitative research can be defined as "the correctness or credibility of a description, conclusion, explanation, interpretation or other sort of account" (Maxwell, 1996, p. 87). Some procedures such as searching for discrepant events, triangulation, feedback, member-check, rich data, quasi-statistics and comparisons were suggested to increase the credibility of a qualitative research by Maxwell (1998). As it was not possible to ensure all the suggested procedures, in this study, we tried to ensure the validity of study by adopting member-check, feedback and quasi-statistics procedures.

Member-check: Member check is a systematical way to get feedback about your conclusions from participants with, which is an important way to prevent misinterpretation of the meanings (Maxwell, 1998). To ensure this, the data gathered was coded by each researcher independently and then the coded data was compared to the other researcher's' coding in order to avoid misinterpretations between coders.

Feedback: Seeking feedbacks from a variety of people who are familiar to the setting or context that you are studying with could be a useful strategy to prevent researcher biases. Thus, we got feedback from a science and a mathematics experts who were PhD candidates and were specialized about both science and mathematics curricula and a science teacher about the content of the questionnaire.

Quasi-statistics: The results of qualitative studies could be presented with quantitative components which help researchers to "asses the amount of evidence in your data that bears on a particular conclusion" (Maxwell, 1998; p.95). For instance, tables and graphs and distribution of the observational and interview data could be used to support the conclusions (Maxwell, 1998). Based on this, we also used tables while interpreting the questions in the questionnaire.

Reliability

LeCompte and Goetz (1982) defined reliability as "the extent which studies can be replicated" (p.35). Establishing reliability for a qualitative study could create a problem because of nature of data and

research process (LeCompte & Goetz, 1982). The external and internal reliability of the study were ensured as explained below:

The external reliability in qualitative studies can be ensured by handling researcher status position, informant choices, social situations and conditions, analytic constructs and premises and methods of data collection and analysis (LeCompte & Goetz, 1982). We tried to ensure some of the premises to increase the external reliability of our study as explained below:

Researcher status position: It is important to explain the researchers' role and positions in a qualitative study to ensure external reliability (LeCompte & Goetz, 1982). We informed the teachers who voluntarily wanted to take part in the study about the aim of the study. We preferred to be not at the class in order to prevent students' possible reactions to new people. The teachers applied the questionnaire to their students during their course.

Informant choices: Another important point in qualitative studies is to identify the informant who provides data (LeCompte & Goetz, 1982). We chose a school among a group of schools which had similar socioeconomic status (SES) based on our time and access constraints as well as voluntary participation of teachers for the study. We chose a school which had middle to low SES students.

FINDINGS

In the first part of this section, the findings regarding students' total test scores were presented. In the second part, students' correct, incorrect, and partial answers in each question were presented with frequency tables. The common mathematical errors found in force and motion unit were discussed.

Investigation of seventh grade students' total test scores in force and motion unit; In this part, students' total test scores in force and motion unit were presented. Students' correct answers were scored as 10 points, while students' incorrect answers were scored as 0 points. When students' total scores were computed, a student who correctly answered all eight questions could be given a maximum of 80 points (10 points for each). To make clear interpretations, scores were converted from out of 80 points to out of 100 points. Then the test scores were grouped and the total number of students in each test score group was determined. The students' total scores in each group were presented in Table 2.

Table 2. Students' Total Scores in Force and Motion Unit

Scores (Grouped)	Total number of Participants	Percentage (%)	Cumulative percentage (%)
91-100	0	0	100
81-90	1	0.78	100
71-80	8	6.20	99.22
61-70	10	7.75	93.02
51-60	14	10.85	85.27
41-50	13	10.08	74.42
31-40	9	6.98	64.34
21-30	11	8.53	57.36
11-20	43	33.33	48.83
0-10	20	15.50	15.50

As indicated in Table 1, majority of students' total scores were found to be 50 and under 50 (74.4%). In other words, only a quarter of the students scored over 50 points. That means majority of students did not answer half of the questions correctly. More interestingly, none of the students could correctly answer all the questions in the test. Only one student was able to obtain a score between 81 and 90 points. Besides, 15.5% of the students answered only one question or none of the questions correctly. Furthermore, more than a quarter of the students received a score of 20 or less points. Overall, these findings yielded that students had difficulties in answering the questions in force and motion unit. As these questions required some mathematical knowledge in their solution, we concluded that students encountered mathematical difficulties during solution of questions in the questionnaire. Thus, we further analyzed students' answers with respect to mathematical errors.

To categorize students' mathematical difficulties in force and motion unit, each question was further examined in detail and difficulty categories were revealed according to the structure of the questions.
Students' mathematical difficulties in force and motion unit; In this part, students' mathematical difficulties with respect to each question were examined and findings were represented by using frequencies and tables.
Students' mathematical difficulties in Question 1: The relationship between length and mass of a spring was asked for the purpose of investigating students basic graph reading skills specifically reading line graphs in the first question (see Appendix for this question given as a sample). The number of students who incorrectly answered the question and the percentage of incorrect responses was presented in Table 3.

Table 3. The Number of Students' Incorrect Answers in Question 1

	Related mathematical difficulty
	Reading graph
Number of students with incorrect answer	34
Percentage (%)	26

As seen from Table 3, more than a quarter (26%) had difficulty in reading and interpreting the given line graph. That means 74% of the students were able to interpret the line graph in given question and correctly answered the question.
Students' mathematical difficulties in Question 2: The second question investigated whether students could correctly use ratio and proportion (specifically direct proportion) after reading line graph of a spring as a follow up for the first question. The number of students who incorrectly answered the question and the percentage of incorrect response were presented in Table 4.

Table 4. The Number of Students' Incorrect Answers in Question 2

	Related mathematical difficulty	
	Reading graph	Direct proportion
Number of students with incorrect answer	94	94
Percentage (%)	73	73

As seen from the table 4, when the question got complicated and consisted of several parts (reading line graph and using direct proportion in this case) unlike the first question (just required reading and interpreting line graph), majority of students had more difficulties in the question (73%). As the question got complicated, the number of students' incorrect answers was increased. The students, who could not correctly read line graph, were not able to solve second question and its parts.
Students' mathematical difficulties in Question 3: Third question included three parts as a combination of rate-ratio, unit conversion and reading line graphs as a follow up for first and second question. As the question got complicated, the number of students who incorrectly answered the question was increased. Close examination revealed that 95 students could not answer any part of the question (regarding reading line graphs, rate-ratio and unit conversion). Additionally, while 23 students answered this question regarding rate-ratio step and reading line graph steps, they could not considered the unit conversion part (centimeter to meter conversion). Only nine students out of 129 students correctly handled all the parts of questions and reached the correct answer. It can be concluded that the most difficult part of question that students encountered was the unit conversion part. 118 out of 129 students (91.5%) could not convert the units. Even unit conversion was learned as an objective of fourth grade mathematics curriculum, great majority of seventh grade students had difficulty in converting units. This may be caused because of the students' being unaware of the unit that was asked in the question or not correctly doing first steps of the question.
Overall, when the first three questions interpreted together, we concluded that as the question got complicated and included more than one step in its solution, the number of students that were able to correctly answer the question slightly decreased.
Students' mathematical difficulties in Question 4: Fourth question consisted of two parts as applying the work formula and converting unit from km to meters. The number of students who incorrectly answered the question and the percentage of incorrect response were presented in Table 5.

Table 5. The Number of Students' Incorrect Answers in Question 5

	Related mathematical difficulty	
	Unit conversion	Using formula
Number of students with incorrect answer	129	65
Percentage (%)	100	50

In this question, nearly half the students could not apply work formula. In addition, all the students could not convert units. This finding is consistent with the findings of third question indicating students' difficulties in converting units were common regardless of question type. Even unit conversion was learned and as an objective of fourth grade mathematic curriculum, great majority of seventh grade students had great difficulty in unit conversion in related questions. Only small number of students could correctly convert units (for instance, from km to meters).

Students' mathematical difficulties in Question 5: In fifth question, students were asked to order three different objects which have different masses and different heights after computing their potential energies. The number of students who incorrectly answered the question and the percentage of incorrect response were presented in Table 6.

Table 6. The Number of Students' Incorrect Answers in Question 5

	Related mathematical difficulty	
	Using Formula	Ordering
Number of students with incorrect answer	98	96
Percentage (%)	76	74

Majority of students were unable to apply formula to compute the potential energies of objects (76%) (See Table 6). A similar percentage (74%) was also unable to correctly order the given objects. Less than a quarter (16%) could correctly apply potential energy formula and order.

Students' mathematical difficulties in Question 6: In sixth question, students were asked to order three different vehicles which have different masses and different velocities after computing their kinetic energies. A great majority of students were unable to apply formula to compute the kinetic energies of objects (94%) (See Table 7). Relatively fewer students were (78%) also unable to correctly order the kinetic energies of given vehicles. 6 students out of 129 total participants correctly answered both part of question (using formula and ordering).

Table 7. The Number of Students' Incorrect Answers in Question 6

	Related mathematical difficulty	
	Using Formula	Ordering
Number of students with incorrect answer	121	100
Percentage (%)	94	78

When the questions that required ordering after application of formulas in related questions (Question 5 and 6) were interpreted together, it was evident that even most students knew the formulas, whereas they had difficulties in applying them and then in ordering based on their findings. This difficulty in ordering and applying formulas in force and motion unit were not seen in previous studies (e.g., Butuner and Uzun, 2011).

Students' mathematical difficulties in Question 7 and Question 8: In seventh question, three gears which are connected were presented. Students were asked to use inverse proportion to calculate the number of turn of a gear by using another gear's number of turns and teeth. More than half of the participants (62%) could not correctly answer the questions (see Table 8). On the other hand, 49 students could correctly use inverse proportion.

Table 8. The Number of Students' Incorrect Answers in Question 7

	Related mathematical difficulty
	Inverse proportion
Number of students with incorrect answer	80

Percentage (%)	62

As a follow up for the seventh question, the last question investigated whether students could correctly use inverse proportion when calculating the first gears' number of turns by using third gears' number of turns. The number of students who incorrectly answered the question and the percentage of incorrect response were presented in Table 9.

Table 9. The Number of Students' Incorrect Answers in Question 8

	Related mathematical difficulty Inverse proportion
Number of students with incorrect answer	108
Percentage (%)	84

Findings indicated that a great majority of students (84%) could not correctly answer the question. In contrast, only a small number of students correctly used inverse proportion. Based on the findings of these questions (Question 7 and 8), we came up a conclusion that students had difficulties in regarding ratio and proportion concept (direct and inverse proportion). Although students learned ratio and proportion in previous years (ratio and proportion concept is an objective in 6th grade mathematics curricula) and use ratio and proportion concept in other science subjects, there were unable to use direct and inverse proportion.

DISCUSSION

We found that seventh grade students had difficulties in force and motion unit. The studies in the literature that examined students' difficulties in physics concepts (e.g., Akatugba & Wallece, 1999; Aycan & Yumusak, 2003; Corlu & Corlu, 2012; Kararkuyu, 2008; Oon & Subramaniam, 2011; Sahin & Yagbasan, 2012) concluded that student' lack of understanding in mathematics concepts caused these difficulties. We also, came up a similar conclusion as students showed mathematical difficulties in their answers in force and motion unit. The close examination revealed that while most of the students were able to interpret line graphs, this number decreased as the question got complicated and included several steps in its solution. Most of the students were unable to answer the question that includes both interpretation of line graph and using direct proportion. The difficulties in interpreting the graphs (Capraro et al. 2005; Demirci & Uyanik, 2009; Roth & Bowen, 1999) as well as proportional concepts (Akatugba & Wallece, 1998; Howe et al. 2010a, 2010b; Lamon, 2007) was also reported in the studies that investigated students' difficulties in physics. The reason of students' difficulties in proportional concepts was explained as students' being unaware of use of proportional concepts including ratios and proportions in solving physics tasks (Akatugba & Wallace, 1999). In addition, we found that students had difficulties in applying formulas. This finding was in line with the literature that reported students had difficulties in applying formulas into physics problems (Corlu & Corlu, 2012; Karakuyu, 2008). Even science context is appropriate for developing and fostering computational fluency (Corlu et al. 2011), the students in our study showed very low achievement in the questions which included both mathematical computation skills and mathematical interpretation.

We found that unit conversion was the most problematic point for students. This finding was in line with Butuner and Uzun's (2011) study that reported science teachers' experienced difficulties in teaching concepts in force and motion unit. In their study, science teachers indicated that drawing and interpreting graphs, ratio and proportion, and unit conversion were reported mathematical difficulties in force and motion unit (Butuner & Uzun, 2011). Similarly, Kocaoğlu and Yenilmez (2010) reported students' difficulties in converting units. Specifically, we found that students had severe difficulties in unit conversion. Only very few students were able to convert the units (for instance, from km to meters). This was an interesting result because unit conversion had been taught at primary grades. Even unit conversion was learned and as an objective of fourth grade mathematic curriculum, great majority of seventh grade students had great difficulty in unit conversion in related questions.

In addition to these findings, we revealed other mathematical difficulties including applying the formula, ordering, ratio and proportion in force and motion unit. While students' difficulties in using mathematical formulas (Corlu & Corlu, 2012, Karakuyu, 2008) and ratio and proportion including direct

and inverse proportion (Akatugba & Wallece, 1999; Dole & Shield, 2008; Howe et al. 2010a, 2010b ; Lamon, 2007) were reported in literature, ordering and applying formulas in force and motion unit were not widely investigated in previous studies (e.g., Butuner and Uzun, 2011). While ratio and proportion was taught at seventh grade mathematics classes, direct and inverse proportion were subject of seventh grade mathematics curriculum. Besides having difficulties in ratio and proportion which was taught in previous years, seventh grade students had confusions in direct and inverse proportion topics which they had just learned. Even though these concepts were given in sixth and seventh grades, we found that seventh grade students still had difficulties in these concepts.

As a conclusion, we can conclude that students' experienced difficulties in mathematics such as applying formulas, converting units or understanding and interpreting graphs may explain their low achievement in science. As this study was qualitative in nature, we did not aim to generalize our findings to all seventh grade students. Also, as this study was not a causal-comparative study that explores the students' low achievement in science whether caused by mathematics or not, we could not say that students' difficulties in science specifically force and motion unit was caused by their low competence in mathematics. But we can conclude that their incompetence in mathematical concepts such as ratio and proportion, unit conversion, basic mathematical computational skills may influence their understanding in science concepts. As Cetin and his colleagues (2015) found strong relationship between students' mathematics and science achievement, it is needed to explore this relationship by using multiple methods. To further analyze the relationship between competence in mathematics and understanding in science, it is needed to conduct experimental studies including implementations as well as more qualitative studies including semi-structured interviews and classroom observations.

Implications

As previous studies reported that integration of science and mathematics enhance students' achievement (e.g., Hurley, 2001; Kiray & Kaptan, 2012; Wang, 2005), students' motivation and problem solving ability (Offer & Vasquez-Mireless, 1999) and helps students to make abstract concepts more concrete, integrated curricula for science and mathematics might be useful for developing students' understanding in both disciplines as well as increase their achievement. While developing integrated curricula for science and mathematics, the role of content knowledge, pedagogical content knowledge (Frykholm & Glassom, 2005) and integrated teaching knowledge (Corlu, Capraro, & Capraro, 2014; Corlu, Capraro, & Çorlu, 2015) should be taken into consideration.

In order to increase students' motivation and academic achievement in both disciplines, an integrated teacher education program that consider the importance of integration of both disciplines is needed. Berlin and White (2012) indicated although there was integrated science and mathematics methods course approach, there is relatively few teacher preparation or enhancement programs for elementary and middle school levels. So, both development and implementation of these preparation and enhancement programs is strongly needed. In Berlin and White's (2012) 7-year mathematics-science and technology program for pre-service teachers, they reported regardless of the certification area, teachers showed positive attitudes and perceptions related to the value of the integration of mathematics, science, and technology education over all seven years of the program. Thus, adopting this kind of programs in pre-service teacher education programs may be helpful in developing pre-service teachers' appreciation of integration of mathematics and science as well as other disciplines. Also, both pre-service and in-service teachers that appreciate the role of collaboration and teamwork with their colleagues in numerous studies have been reported (Berlin & White, 2012; Frykholm & Glasson, 2005; Riordain et al. 2015). As Berlin and White (2012) proposed, this kind of program might be helpful in increasing the implementation of interdisciplinary teaching and learning activities. Riordain et al. (2015) reported that teachers have positive views about the benefits of integration with respect to students' learning and motivation in their study. This positive view of teachers may be helpful in designing and implementing integrated science and mathematics lessons.

As Berlin and White (2012) reported in their historical analysis of integration for one hundred years, there is a need for empirical based research about integration of science and mathematics. Thus, another important implication may be increasing the number of empirical based research about the integration of science and mathematics. The different forms of integration proposed by Hurley (2001), sequential (science and mathematics are planned sequentially), parallel (science and mathematics are planned and taught at the same time), partial (the two disciplines are partially taught together and partially taught

separately), enhanced (while on of the disciplines is the major discipline of instruction, the other is used throughout the instruction) and total (two disciplines are taught evenly) forms can be employed in these kind of empirical research studies. A meta-analysis of 31 studies by Hurley (2001) revealed that science achievement is more apparent in either enhanced (mathematics used to enhance science) or total (mathematics and science totally integrated) integration models. Thus, enhanced and total integration models can be used in these empirical research studies.

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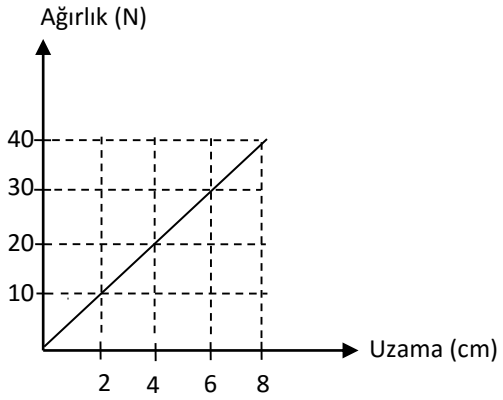
APPENDIX

Sample Questions Types

Question 1.

The graphing representing of the relationship between the length and mass of a spring was given below.



Based on the graph given above, find the elongation which is caused by 30 N.

Related Area: *Reading Line Graphs*

Question 3 (A Follow up question for students by using same graphs)

Based on the graph given above, find the difference in the elongation of spring in meter when 60N is applied.

Related Area: *Rate-Ratio, Unit Conversion and Reading Line Graphs*

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Öğretmen Yetiştirme Araştırma Makalesi

Türkiye'de teknolojik pedagojik alan bilgisi üzerine 2009-2013 yılları arasında yapılan çalışmalardaki eğilimler

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ÖZ Bu araştırma, Teknolojik Pedagojik Alan Bilgisi (TPAB) ile ilgili Türkiye kaynaklı yapılmış çalışmaları; yayın yılı, yayın türü, araştırma konuları, uygulama alanları, örneklem seçimi, örneklem düzeyi, araştırma yöntemi, veri toplama aracı ve veri analiz yöntemi açısından incelemeyi amaçlamaktadır. Araştırmanın örneklemini 2009-2013 yılları arasında yapılan 32 makale ve 17 tez olmak üzere 49 çalışma oluşturmaktadır. Araştırma kapsamına alınan çalışmalar içerik analizi yapılarak elde edilen sonuçlar araştırma sorularına yanıt verecek şekilde yüzde, frekans gibi betimsel istatistik yöntemleriyle analiz edilmiştir. Elde edilen bulgulara göre, Türkiye'de TPAB ile ilgili yapılan çalışmaların yıllara göre arttığı, öğretmenlerin TPAB düzeylerinden çok öğretmen adaylarının TPAB düzeylerini inceleyen çalışmaların yapıldığı, en çok tercih edilen uygulama alanlarının matematik ve fen olduğu, araştırma yöntemi olarak nicel yöntemlerin daha çok uygulandığı ve veri toplama aracı olarak da anketin daha çok kullanıldığı görülmüştür. Bu çalışmada elde edilen verilerin analizi istatistiksel olarak yorumlanmış; TPAB çerçevesine yaptığı katkı literatüre dayalı olarak tartışılmıştır.

Anahtar Kelimeler *Teknolojik pedagojik alan bilgisi, Türkiye'de yapılan çalışmalar, içerik analizi.*

Trends in studies on technological pedagogical content knowledge in Turkey between 2009 and 2013 years

ABSTRACT This study aims to investigate studies about Technological Pedagogical Content Knowledge (TPCK) conducted in Turkey, in terms of publication year, publication type, research topics, implementation areas, sample selection, sampling level, research methodology, data collection instruments and data analysis methods. The sample of the study consists of 49 (32 articles and 17 theses) studies conducted between 2009 and 2013 years. The results obtained through content analysis were analyzed by descriptive statistical methods such as percentage and frequency distributions in order to answer the research questions. According the findings; TPCK related studies in Turkey increased by year, pre-service teachers TPCK levels investigated more than teachers TPCK levels, the most preferred field is mathematics and science in the studies, quantitative methods were applied mostly, and surveys were used more than other data collection instruments. The analysis of the data obtained in this study were interpreted statistically and contribution to the TPCK framework has been discussed based on the literature.

Keywords *Technological pedagogical content knowledge, studies in Turkey, content analysis.*

EXTENDED SUMMARY

Nowadays, the rapid development of technology has brought different ideas about technology integration in education, and it has been shown that technological innovation alone is not enough for technology integration in educational environments. Thus, the framework of technological pedagogical content knowledge has been established in order to understand the level of knowledge of teachers, who play a key role in the integration of technology in education. Technological pedagogical content knowledge consists of a combination and interaction of technological knowledge, pedagogical knowledge and content knowledge. Of these, Technology Knowledge (TK) refers to the knowledge about various technologies ranging from ordinary instruction material to advanced digital technologies. Pedagogical Knowledge (PK) includes generic knowledge about the structure, organization, management, and teaching strategies regarding how to teach a specific content domain. The Content Knowledge (CK) is the knowledge to be taught by teachers regarding the topic. Pedagogical Content Knowledge (PCK) is the knowledge about the simulations, illustrations, examples, explanations and demonstrations used by teachers for effective presentation of the content. Technological Content Knowledge (TCK) refers to knowledge about the use of technology to convey the content domain. Technological Pedagogical Knowledge (TPK) refers to the affordances and constraints of technology regarding pedagogical designs and strategies appropriate for disciplinary and developmental aspects. Technological Pedagogical Content Knowledge (TPCK) refers to the knowledge and understanding of the interaction between TK, PK, and CK when using technology for teaching concepts. According to Mishra & Koehler (2006), the TPCK framework allows teachers to understand the complexity of relationships between concepts when integrating technology with education.

It is seen that there are many studies about TPCK due to contributions of TPCK on teacher competencies regarding technology integration with education, as well as meta-analysis studies analyzing these studies. Wu (2013) investigated the yearly distribution, sampling groups, subject fields and research methodologies of 24 experimental studies about TPCK published in journals indexed by SSCI between 2002 and 2011, and as a result of the analyses he concluded that experimental studies has increased significantly, and most of the studies has been conducted with pre-service teachers, instead of working teachers. Voogt, Fisser, Pareja Roblin, Tondeur, and van Braak (2013) have analyzed 55 studies on TPACK published between 2005 and 2011 in Education Resources Information Center (ERIC), Web of Science, Scopus, and PsychINFO databases in terms of theoretical foundations and practical uses, and as a result of the analysis of findings concluded that there are different understandings of TPCK and TK, leading various views regarding the measurement of TPCK, the concepts related to TPCK are hard to understand, thoughts about TPCK, PK and TK are intertwined, and technology-enriched courses based on active participation is a promising strategy for improving TPCK of teachers. It has been seen that evaluation of various studies on TPCK conducted worldwide makes a major contribution to the literature. As much as being a summary of the studies carried out so far, these studies which examines the studies about TPCK are expected to shed light on future studies. In this context, this study aims to investigate studies about TPCK conducted in Turkey, in terms of publication year, publication type, research topics, implementation areas, sample selection, sampling level, research methodology, data collection instruments and data analysis methods. The sample of the study consists of Turkey-based articles published between 2009 and 2013 in journals indexed by SSCI and ULAKBİM (National Academic Network and Information Center of Turkey) database, as well as theses published in full text in the YÖK (The Council of Higher Education) thesis database. In order to determine the studies to be investigated within the scope of the research, the keywords "Technological Pedagogical Content Knowledge", and "TPCK" were searched in SSCI Journals, ULAKBİM and YÖK thesis databases. This search yielded 49 studies, consisting of 32 articles and 17 theses. Data obtained by examining the studies within the scope of this research were recorded in an electronic form into the publication classification form of TPCK, and the results obtained through content analysis were analyzed by descriptive statistical methods such as percentage and frequency distributions in order to answer the research questions.

According to results, an increase in the number of studies conducted on TPCK is on the rise in Turkey between 2009 and 2013 years. And, this indicates an increasing tendency towards TPCK research in Turkey. The relationship between achievement levels, various demographic variables (age, gender, experience etc.) and TPCK, the relationships between technology integration in education and TPCK, the effects of course, workshop, instruction, etc. practices on the development of TPCK are the most

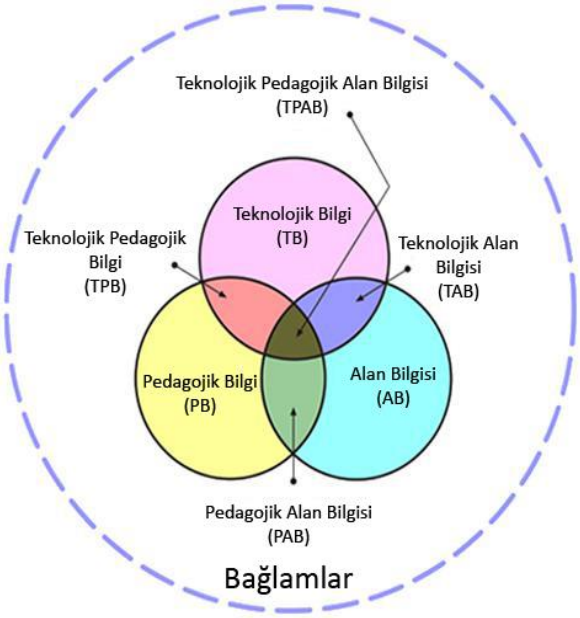
researched topics in TPCK-related studies. Mathematics and science were found to be the most preferred application areas according to the majority of the research. Looking at the levels of sampling, it's observed that the majority of studies investigated levels of TPCK of pre-service teachers, rather than branch teachers or primary school teachers. Considering the research methodologies, it's understood that quantitative methods were applied mostly; and, among the data analysis methods, descriptive analysis method was found to be the preferred qualitative analysis method, compared to other data analysis approaches. And, looking at the data collection instruments, it's seen that questionnaires and interview forms were used more than other data collection instruments. In this context, it's understood that studies on TPCK are increasing in number and variety day by day, and future studies are needed to be conducted with different methods in different domains. Since there were many studies investigating the relationship between various demographic variables and achievement levels in TPCK, there is a need for studies on different subject areas.

As in the fields of mathematics and science, studies on TPCK in other fields should be increased, particularly in the field of information technology, which plays a key role in the integration of technology with education. When considered in the context of technology integration with education, it is extremely important to increase studies on the levels of TPCK of working teachers, as much as the studies conducted with pre-service teachers. Focusing on qualitative and mixed-type studies, as well as quantitative studies to be conducted about TPCK will make a great contribution to the literature. As a result, it is thought that investigation of studies on TPCK within the context mentioned above will contribute to the literature, will reveal the differences and similarities between the studies, and will shed a light on future studies.

GİRİŞ

Günümüzde teknolojinin hızla ilerlemesi eğitime teknoloji entegrasyonu konusunda da farklı fikirleri beraberinde getirmiştir. Eğitime teknolojik yenilik getirmeyi sorguladığımızda, bu yeniliğin pedagoji, insan ve performans boyutlarını içerdiğini görmekteyiz (Ferdig, 2006). Bu bağlamda eğitime teknoloji entegrasyonunda sadece teknolojinin değişimi tek başına sağlamadığı (Koehler ve Mishra, 2005), öğretmenlerin teknolojiyi kullanma şeklinin eğitimi değiştirme potansiyeline sahip olduğu görülmektedir (Carr, Jonassen, Litzinger ve Marra, 1998). Sınıf içi öğretme etkinliklerini planlama ve uygulamada öğretmenin niteliği, yeterliği ve deneyimi önemli yer tutmaktadır (Demir ve Bozkurt, 2011). Bunlara bakarak eğitime teknoloji entegrasyonu sürecinde, öğretmen yeterliliğinin son derece önemli olduğunu söyleyebiliriz.

Shulman (1987) öğretmen yeterliklerinin; alan bilgisi, pedagojik bilgi, pedagojik alan bilgisi, müfredat bilgisi, öğrenen özellikleri bilgisi, eğitsel bağlam bilgisi, eğitsel çıktılar, amaçlar, değerler, felsefik ve tarihi temeller hakkında bilgi başlıklarını içermesi gerektiğini belirtmiştir. Shulman'ın (1987) öğretmen yeterliliklerinde belirtmiş olduğu pedagojik alan bilgisi kavramına, Koehler ve Mishra (2005) teknolojik bilgi kavramını da dahil ederek Teknolojik Pedagojik Alan Bilgisi (Technological Pedagogical Content Knowledge - TPACK) çerçevesini oluşturmuşlardır. Teknolojik Pedagojik Alan Bilgisi (TPAB), Teknolojik Bilgi (TB), Pedagojik Bilgi (PB) ve Alan Bilgisinin (AB) birleşimi olmakla birlikte, TPAB her bir parçanın toplamından daha anlamlı bir bütünü ifade etmektedir (Koehler & Mishra, 2005). TB; sıradan ders materyallerinden, gelişmiş dijital teknolojilere kadar sıralanabilecek çeşitli teknolojiler hakkındaki bilgidir (Pamuk, Ülken ve Dilek, 2012). PB; belirli bir konu alanının nasıl öğretileceğiyle ilgili yapı, organizasyon, yönetim ve öğretim stratejileri hakkındaki bilgidir (Wetzel, Foulger ve Williams, 2008-2009). AB; konu alanıyla ilgili öğretmenin ne öğreteceği hakkındaki bilgidir (Mishra ve Koehler, 2006; Wetzel vd., 2008-2009; Baran, Chuang ve Thompson, 2011). PAB; öğretmenin ders anlatırken kullandığı; konuların etkili sunumu, güçlü benzeşimler, çizimler, örnekler, açıklamalar ve gösteriler hakkındaki bilgidir (Shulman, 1986). TAB; konunun teknolojik araçlar ile dönüşümünün sağlanması hakkındaki bilgidir (Koehler ve Mishra, 2009; Kereluik, Mishra ve Koehler, 2011; Pamuk vd., 2012). TPB; disiplinsel ve gelişimsel açıdan uygun pedagojik tasarım ve stratejilerle ilgili olarak, bir dizi teknolojik aracın pedagojik olanakları ve sınırlılıkları hakkındaki bilgidir (Koehler ve Mishra, 2009). TPAB; TB, PB, AB bilgi alanlarının etkileşiminden ortaya çıkan ve teknolojiyi kullanarak kavramların nasıl öğretileceği hakkındaki anlayışla ilgili bilgidir (Mishra ve Koehler, 2006; Kereluik vd., 2011). TPAB boyutlarının birbirleri arasındaki ilişkiyi açıklayan TPAB çerçevesi Şekil 1'de görülmektedir (Koehler ve Mishra, 2005).



Şekil 1. Teknolojik Pedagojik Alan Bilgisi (Koehler, 2012)

Mishra ve Koehler'e (2006) göre eğitime teknoloji entegrasyonunda TPAB çerçevesi; öğretmenlere kavramlar arasındaki karmaşık ilişkiler arasında mantık kurmaya olanak sağlamaktadır. TPAB'ın eğitime teknoloji entegrasyonunda öğretmen yeterliklerine katkısı nedeniyle, TPAB'la ilgili birçok çalışma yapıldığı ve bunun yanında yapılan bu çalışmaları inceleyen çalışmalar da yapıldığı görülmektedir. Wu (2013), 2002-2011 yılları arasında SSCI kapsamındaki dergilerde yayınlanmış TPAB ile ilgili 24 deneysel çalışmanın; yıllara göre dağılımını, örneklem gruplarını, konu alanlarını ve araştırma yöntemlerini incelemiş; analizlerin sonucunda deneysel çalışmaların anlamlı bir şekilde arttığı, öğretmenlerden çok öğretmen adayları üzerinde çalışma yapıldığı sonucuna varmıştır. Voogt, Fisser, Pareja Roblin, Tondeur ve van Braak (2013), 2005-2011 yılları arasında Education Resources Information Center (ERIC), Web of Science, Scopus ve PsychINFO veri tabanlarında yer alan TPAB ile ilgili yapılmış 55 çalışmayı TPAB'ın kuramsal temelleri ve pratik kullanımı açısından incelemiş; bulguların analizinde, TPAB ve TB'ye yönelik farklı anlayışların olduğu, bunun TPAB'ın ölçülmesinde farklı görüşler olmasını da etkilediği, TPAB ile ilgili kavramların zor anlaşıldığı TPAB, PB ve TB hakkındaki inançların iç içe geçtiği, aktif katılımlı yeniden tasarlanan teknolojiyle zenginleştirilmiş derslerin öğretmenlerin TPAB gelişimi için umut verici bir strateji olduğu sonuçlarına ulaşmıştır.
Dünya'da TPAB ile ilgili yapılmış çeşitli çalışmaların incelenerek yorumlanmasının literatüre büyük bir katkı sağladığı görülmüştür. TPAB ile ilgili yapılmış çalışmaların incelendiği çalışmalar (Voogt vd., 2013; Wu, 2013); bugüne kadar yapılan çalışmaların bir özeti olduğu gibi, bu tarz çalışmaların gelecekte yapılacak ilgili çalışmalara da örneklem grupları, araştırılan konu alanları, araştırma yöntemleri, kuramsal temeller ve bunların uygulamaları bağlamında ışık tutacağı düşünülmektedir. Bu bağlamda, bu araştırmada TPAB ile ilgili yapılmış Türkiye adresli çalışmaların ortaya konulması ve çeşitli değişkenler açısından incelenmesi amaçlanmaktadır. Araştırmanın amacı doğrultusunda aşağıdaki sorulara yanıt aranmıştır:
TPAB ile ilgili yapılmış çalışmalar yıllara göre farklılık göstermekte midir?
TPAB ile ilgili yapılmış çalışmalarda hangi konular araştırılmıştır?
TPAB ile ilgili yapılmış çalışmalar uygulanan branşlara göre farklılık göstermekte midir?
TPAB ile ilgili yapılmış çalışmalar örneklem seçimlerine göre farklılık göstermekte midir?
TPAB ile ilgili yapılmış çalışmalar örneklem düzeylerine göre farklılık göstermekte midir?
TPAB ile ilgili yapılmış çalışmalarda hangi yöntemler yaygın olarak kullanılmıştır?
TPAB ile ilgili yapılmış çalışmalarda hangi veri toplama araçları tercih edilmiştir?
TPAB ile ilgili yapılmış çalışmalarda hangi veri analizi yöntemleri yaygın olarak kullanılmıştır?

YÖNTEM

TPAB ile ilgili yapılmış Türkiye adresli çalışmaların inceleneceği bu araştırmada nitel araştırma desenlerinden doküman inceleme yöntemi kullanılmış; toplanılan verileri açıklayabilmek için gerekli kavram ve ilişkilere ulaşmak amacıyla nitel analiz yöntemlerinden içerik analizi yöntemi kullanılmıştır. Bu çalışmada içerik analizi yöntemi kullanılmasının nedeni araştırma için toplanılan verilerin önce kavramsallaştırılması, sonrasında ortaya çıkan kavramlara göre mantıksal olarak şekillendirilmesi ve buna göre verileri açıklayan temaların belirlenmesi gerekmektedir. İçerik analizi verileri tanımlamamızı ve belirli çerçevelerde bir araya getirmemizi sağlamaktadır (Yıldırım ve Şimşek, 2011, s. 227). Araştırmanın kapsamı, veri toplama süreci ve veri analiz işlemler bu bölümde belirtilmiştir.

Araştırmanın Kapsamı

Araştırmanın kapsamını 2009-2013 yılları arasında Teknolojik Pedagojik Alan Bilgisi ile ilgili yapılmış Türkiye adresli çalışmalar oluşturmaktadır. Bu bağlamda araştırma; SSCI kapsamındaki dergilerde yayınlanmış makaleleri, ULAKBİM ulusal veri tabanlarında dizinlenen eğitim bilimleri dergilerinde yayınlanmış makaleler ile YÖK tez veri tabanında yayınlanmış tezleri kapsamaktadır.

Veri Toplama Süreci

Araştırma kapsamında incelenecek çalışmaları belirlemek amacıyla SSCI kapsamındaki dergilerde, Ulakbim ve YÖK tez veritabanında "Teknolojik Pedagojik Alan Bilgisi", "TPAB", "Technological Pedagogical Content Knowledge" ve "TPACK" anahtar sözcükleri kullanılarak tarama yapılmıştır. Tarama sonucunda TPAB ile ilgili 25 farklı dergide 32 makale, YÖK tez veritabanında ise 14'ü yüksek lisans, 3'ü doktora tezi olmak üzere toplamda 17 tez çalışması tespit edilmiş ve araştırma kapsamında

incelenmiştir. Elde edilen tüm çalışmaların bulunduğu dergiler ve yıllara göre dağılımı Ek 1'de ve tam referanslarını içeren liste Ek 2'de sunulmuştur.
Araştırma kapsamına alınması kararlaştırılan çalışmalardan ayrı ayrı incelenerek elde edilen veriler, Göksu, Özcan, Çakır ve Göktaş (2014) tarafından geliştirilen "Öğretim Tasarımı Modeli Yayın Sınıflandırma Formu"ndan (ÖTMYSF) yararlanılarak oluşturulan "Teknolojik Pedagojik Alan Bilgisi Yayın Sınıflandırma Formu"na (TPABYSF) elektronik ortamda kaydedilmiştir. Böylece çalışmanın güvenirliği ve iç geçerliği sağlanmaya çalışılmıştır. TPABYSF'de yayın türü, yayın yeri, yıl, yöntem, veri toplama aracı, örneklem sayısı, örneklem seçim şekli, örneklem düzeyi, uygulama alanı, araştırma konusu ve veri analiz yöntemi başlıkları yer almaktadır.

Veri Analizi

Tarama sonucunda TPAB ile ilgili olduğu tespit edilen 49 çalışma; araştırma konusu, veri analiz yöntemi, veri toplama aracı, TPAB'ın incelendiği alanlar, örneklem seçimi, örneklem düzeyi ve kullanılan yöntemler açısından incelenmiştir. Araştırma sürecinde yapılan içerik analizi sonucunda elde edilen veriler, araştırmacılar tarafından araştırma sorularına yanıt verecek şekilde belirlenen temalara göre betimsel istatistik yöntemleri (yüzde, frekans vb.) kullanılarak çözümlenmiştir. Elde edilen verilerin frekans ve yüzde oranları, araştırma sorularına yanıt verecek şekilde araştırmacılar tarafından hesaplanmış, kodlayıcılar arasında güvenirliği sağlamak için Miles ve Huberman'ın (1994) belirlemiş olduğu "güvenirlik=görüş birliği/(görüş birliği+görüş ayrılığı)" formülünden yararlanılmış, temalar için kodlama güvenirliği oranlarının her bir tema için %90'nın üzerinde olduğu tespit edilmiştir. Güvenirlik hesaplamalarının %70'in üzerinde çıkması, araştırmanın güvenilir olarak kabul edilmesi için yeterli görülmektedir (Miles ve Huberman, 1994). Elde edilen veriler düzenlenmiş, gruplanmış, sayısal hale getirilerek tablolar halinde sunulmuş ve son olarak ortaya çıkan bulgular yorumlanmıştır.

BULGULAR

Bu bölümde TPAB ile ilgili yapılmış çalışmalarla ilgili; yayın yılı, araştırma yöntemi, veri toplama aracı, veri analiz yöntemi, araştırma konuları, uygulama alanları, örneklem seçimi, örneklem düzeyi ve kullanılan yöntemlere ait bulgulara yer verilmiştir. TPAB ile ilgili yapılmış çalışmaların yıllara göre dağılımlarını belirtmek amacıyla, her bir yıla ait istatistikler Tablo 1'de sunulmuştur.

Tablo 1. TPAB ile İlgili Yapılmış Çalışmaların Yıllara Göre Dağılımı

	2009	2010	2011	2012	2013	Toplam
Makale	1	1	6	8	16	32
Tez	2	1	6	5	3	17
Toplam	3	2	12	13	19	49

TPAB ile ilgili yapılmış çalışmaların yıllara göre dağılımına ait betimsel istatistiklere bakıldığında, TPAB ile ilgili yapılan çalışmaların toplam sayılarında yıllara göre artış olduğu görülmektedir. Yayın sayısındaki bu artışa bakarak Türkiye'de TPAB konusuna olan eğilimin arttığını söyleyebiliriz.

Araştırma Konularına Göre TPAB ile İlgili Yapılmış Çalışmalar

TPAB ile ilgili yapılmış çalışmalar araştırma konularına göre incelenmiştir. Araştırma konularının toplam frekansının 58 olmasının sebebi, bazı araştırmalarda birden fazla konunun araştırılmış olmasıdır. Araştırma konularına ait betimsel istatistikler Tablo 2'de sunulmuştur.

Tablo 2. Araştırma Konularının Dağılımı

Araştırma Konusu	*f*	%
Çeşitli demografik değişkenler ve TB, PB, AB, TPB, TAB, PAB, TPAB bilgisi düzeyleri arasındaki ilişki	18	31.04
Eğitime teknoloji entegrasyonu ve TPAB arasındaki ilişkiler	11	18.97
Kurs, çalıştay, ders vb. eğitim uygulamalarının TPAB gelişimine etkisi	11	18.97
Ölçek geliştirme ve çeviri çalışmaları	9	15.51
Farklı konu alanlarında TPAB düzeyleri	9	15.51
Toplam	58	100

Tablo 2 incelendiğinde TPAB ile ilgili yapılmış çalışmalarda en çok araştırılan konunun yaş, cinsiyet, akademik başarı, deneyim, branş gibi çeşitli demografik değişkenler ve TPAB çerçevesinin bileşenleri arasındaki ilişki (f=18) olduğu görülmektedir. Eğitime teknoloji entegrasyonu ve TPAB arasındaki ilişkiler (f=11), kurs, çalıştay, ders vb. eğitim uygulamalarının TPAB gelişimine etkisi (f=11) konularının ise ölçek geliştirme ve çeviri ile farklı alanlarda TPAB düzeyleri gibi konulara oranla daha fazla araştırıldığı, ölçek geliştirme ve çeviri çalışmalarının (f=9) ve farklı konu alanlarında TPAB düzeylerini inceleyen çalışmaların (f=9) daha az yapıldığı görülmektedir.

Uygulama Alanlarına Göre TPAB ile İlgili Yapılmış Çalışmalar

TPAB ile ilgili yapılmış çalışmalardan alan yazın derleme çalışması (Kaya ve Yılayaz, 2013) dışında kalan 48 çalışma uygulandığı alanlara göre incelenmiş, TPAB ile ilgili çalışmaların hangi alanlarda uygulandığına dair istatistiksel bilgiler Tablo 3'te verilmiştir.

Tablo 3. Uygulama Alanlarının Dağılımı

Branş	*f*	%
Matematik	19	20.43
Fen ve Teknoloji	13	13.98
Sınıf	10	10.75
İngilizce	8	8.60
Sosyal Bilgiler	8	8.60
Bilgisayar ve Öğretim Teknolojileri	5	5.37
Fizik	4	4.30
Okul Öncesi	4	4.30
Kimya	3	3.23
Biyoloji	2	2.15
Beden Eğitimi	2	2.15
Resim	2	2.15
Müzik	2	2.15
Teknoloji Tasarım	2	2.15
Coğrafya	1	1.08
Din Kültürü ve Ahlak Bilgisi	1	1.08
Özel Eğitim	1	1.08
Tarih	1	1.08
Branş Belirtilmemiş	5	5.37
Toplam	93	100

Tablo 3 incelendiğinde TPAB ile ilgili yapılmış çalışmaların uygulama alanlarına göre farklılık gösterdiği ve en çok çalışma yapılan alanın Matematik (f=19) olduğu görülmektedir. Bununla birlikte, Fen ve Teknoloji (f=13), Sınıf (f=10), İngilizce (f=8) ve Sosyal Bilgiler (f=8) ile ilgili çalışmaların; Bilgisayar ve Öğretim Teknolojileri (f=5), Fizik (f=4), Okul Öncesi (f=4), Kimya (f=3), Biyoloji (f=2), ve Beden Eğitimi (f=2), Resim (f=2), Müzik (f=2), Teknoloji Tasarım (f=2), Coğrafya (f=1), Din Kültürü ve Ahlak Bilgisi (f=1), Özel Eğitim (f=1) ve Tarih (f=1) alanlarıyla ilgili çalışmalardan fazla olduğu tespit edilmiştir.

Örneklem Seçimine Göre TPAB ile İlgili Yapılmış Çalışmalar

TPAB ile ilgili yapılmış çalışmalardan alan yazın derleme çalışması dışında kalan 48 çalışma örneklem seçimine göre incelenmiş, TPAB ile ilgili çalışmalarda hangi örneklem seçim yöntemleri kullanıldığına dair betimsel istatistikler Tablo 4'te verilmiştir.

Tablo 4. Örneklem Seçimi

Örnekleme Yöntemi	*f*	%
Kolay ulaşılabilir	35	72.92
Amaca uygun	7	14.58
Rastgele	6	12.50
Toplam	48	100

Tablo 4 incelendiğinde TPAB ile ilgili yapılmış çalışmaların örnekleme yöntemlerine göre farklılık gösterdiği, en çok kolay ulaşılabilir örnekleme yönteminin (f=35) tercih edildiği, amaca uygun (f=7) ve rastgele (f=6) örnekleme yönteminin ise daha az tercih edildiği görülmektedir.

Örneklem Düzeyine Göre TPAB ile İlgili Yapılmış Çalışmalar

TPAB ile ilgili yapılmış çalışmalardan alan yazın derleme çalışması dışında kalan 48 çalışma örneklem düzeyine göre incelenmiş, TPAB ile ilgili çalışmalarda hangi örneklem düzeylerinde araştırma yapıldığına dair betimsel istatistikler Tablo 5'te verilmiştir.

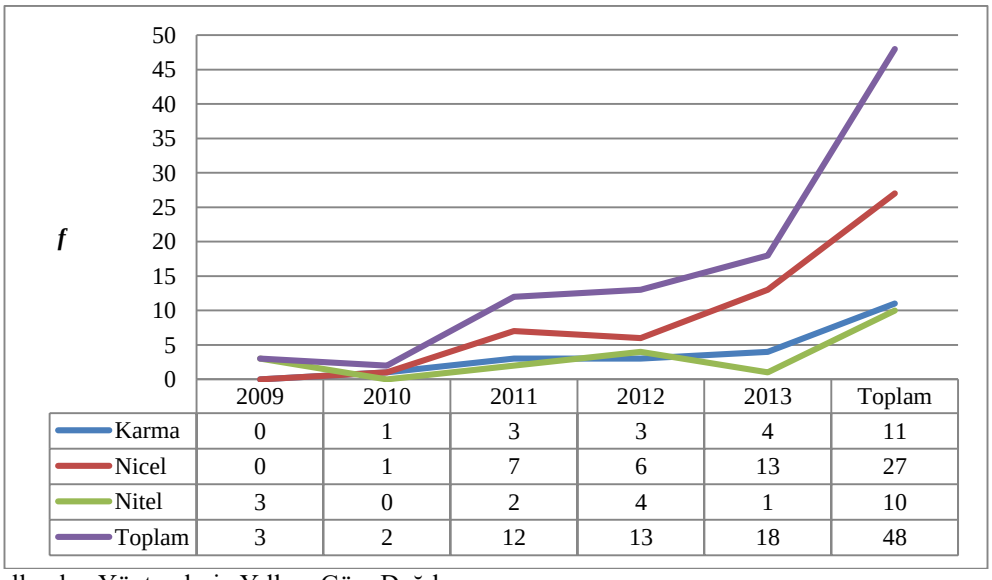
Tablo 5. Örneklem Düzeyi

Örneklem Düzeyleri	*f*	%
Öğretmen adayları	37	77.09
Öğretmen	10	20.83
Akademisyen	1	2.08
Toplam	48	100

Tablo 5 incelendiğinde TPAB ile ilgili yapılmış çalışmaların örneklem düzeylerine göre farklılık gösterdiği; en çok öğretmen adaylarının (f=37) TPAB'ının araştırıldığı, öğretmenlerin (f=10) ve akademisyenlerin (f=1) TPAB'ını inceleyen çalışmaların ise daha az yapıldığı görülmektedir.

TPAB ile İlgili Yapılmış Çalışmalarda Kullanılan Yöntemler

TPAB ile ilgili yapılmış çalışmalardan alan yazın derleme çalışması dışında kalan 48 çalışma, çalışmada kullanılan yöntemlere göre incelenmiş, nicel ve nitel yöntemleri birlikte kullanan çalışmaların yöntemi karma (mixed) (Creswell, 2003) olarak belirtilmiştir. TPAB ile ilgili çalışmalarda uygulanan yöntemlerin yıllara göre değişimini gösteren betimsel istatistikler Şekil 2'de verilmiştir.



	2009	2010	2011	2012	2013	Toplam
Karma	0	1	3	3	4	11
Nicel	0	1	7	6	13	27
Nitel	3	0	2	4	1	10
Toplam	3	2	12	13	18	48

Şekil 2. Kullanılan Yöntemlerin Yıllara Göre Dağılımı

Şekil 2 incelendiğinde TPAB ile ilgili yapılmış olan nicel çalışmaların (f=27) diğer çalışmalardan fazla olduğu, karma yöntemlerin (f=11) ve nitel yöntemlerin (f=10) çalışmalarda daha az tercih edildiği görülmektedir. Çalışmaların yıllara göre dağılımına bakıldığında ise nitel yöntemlerin artık daha az tercih edildiği, nicel ve karma yöntemlerin ise daha çok tercih edilmeye başlandığı görülmektedir.

TPAB ile İlgili Yapılmış Çalışmalarda Kullanılan Veri Toplama Araçları

TPAB ile ilgili yapılmış çalışmalardan alan yazın derleme çalışması dışında kalan 48 çalışma, çalışmada kullanılan veri toplama araçlarına göre incelenmiştir. Veri toplama araçlarının toplam frekansının 79 olmasının sebebi, araştırmaların çoğunda birden fazla veri toplama aracı kullanılmış olmasıdır. Veri toplama araçlarına ait betimsel istatistikler Tablo 6'da sunulmuştur.

Tablo 6. Kullanılan Veri Toplama Araçlarının Dağılımı

Veri Toplama Aracı	*f*	%
Anket	41	51.90
Görüşme Formu	19	24.05
Doküman	9	11.39
Gözlem Formu	7	8.86
Başarı Testi	3	3.80
Toplam	79	100

Tablo 6 incelendiğinde TPAB ile ilgili yapılmış çalışmalarda veri toplama aracı olarak en çok anket (f=41) kullanımının tercih edildiği, görüşme formu (f=19), doküman (f=9), gözlem formu (f=7) ve başarı testi (f=3) gibi veri toplama araçlarının ise daha az tercih edildiği görülmektedir.

TPAB ile İlgili Yapılmış Çalışmalarda Kullanılan Veri Analizi Yöntemleri

TPAB ile ilgili yapılmış çalışmalardan alan yazın derleme çalışması dışında kalan 48 çalışma, çalışmada kullanılan veri analizi yöntemlerine göre incelenmiştir. Veri analizi yöntemlerinin toplam frekansının 88 olmasının sebebi, bazı araştırmalarda birden fazla veri analizi yöntemi kullanılmış olmasıdır. Çalışmalarda kullanılan veri analizi yöntemlerinin dağılımına ait betimsel istatistikler Tablo 7'de sunulmuştur.

Tablo 7. Kullanılan Veri Analizi Yöntemlerinin Dağılımı

Veri Analiz Yöntemi		f	%
Nicel	Betimsel Analiz	37	42.05
	Kestirimsel Analiz	31	35.23
Nitel	İçerik Analizi	13	14.77
	Betimsel Analiz	7	7.95
	Toplam	88	100

Tablo 7'deki veriler incelendiğinde, TPAB ile ilgili Türkiye'de yapılmış çalışmalarda, en çok tercih edilen veri analiz yönteminin nicel analiz yöntemlerinden betimsel analiz yöntemi (f=37) olduğu, kestirimsel analiz yöntemlerinin ise (f=31) daha az tercih edildiği görülmektedir. Nitel analiz yöntemlerinden içerik analizi yöntemi (f=13) ise betimsel analiz yöntemine (f=7) göre daha çok tercih edilmektedir.

TARTIŞMA

Araştırmadan elde edilen bulgular TPAB ile ilgili Türkiye'de yapılan çalışmaların yıllara göre arttığını, araştırılan konular bakımından çeşitlilik gösterdiğini, hemen hemen her alanda uygulanmasına rağmen fen ve matematik alanlarında daha fazla çalışma yapıldığını ayrıca öğretmenlerden çok öğretmen adaylarının TPAB düzeylerini inceleyen çalışmaların yer aldığını göstermektedir. Bununla birlikte; TPAB ile ilgili Türkiye'de yapılmış çalışmalarda kullanılan örneklem seçimi, veri toplama aracı seçimi ve veri analizi yöntemlerinin; Türkiye'de yapılmış farklı alanlardaki çalışmaların örneklem seçimi, veri toplama aracı seçimi ve veri analizi yöntemleriyle benzerlik gösterdiği tespit edilmiştir (Göksu vd., 2014; Göktaş vd., 2012).

Wu (2013) çalışmasında; matematik ve fen alanlarında diğer branşlara oranla daha fazla TPAB ile ilgili çalışma yapıldığını tespit etmiştir. Türkiye'de TPAB ile ilgili yapılan çalışmalarda olduğu gibi Dünya'da yapılan çalışmalarda da matematik ve fen alanlarına yönelik çalışmaların diğer alanlarda yapılan çalışmalardan fazla olması, diğer alanlara yönelik TPAB ile ilgili çalışmalara duyulan ihtiyacı göstermektedir.

Türkiye'de TPAB ile ilgili yapılmış çalışmaların örneklem düzeylerine ait bulgular incelendiğinde; Türkiye ve Türkiye dışındaki ülkelerde yapılan çalışmalarda öğretmenlerden çok öğretmen adaylarının TPAB düzeylerini araştıran çalışmaların yer aldığı anlaşılmaktadır. Wu (2013) TPAB ile ilgili yapılmış deneysel çalışmaları incelediği çalışmasında öğretmenlerden çok öğretmen adaylarına yönelik çalışmaların yer aldığını tespit etmiştir. Öğretmen adaylarının örneklem grubu olarak kolay ulaşılabilir olması veya öğretmenlere yönelik çalışma yapmanın göreceli zorluğu, TPAB ile ilgili yapılmış çalışmaların öğretmenlerden çok öğretmen adaylarına yönelik olmasının nedenleri arasında olduğu

söylenebilir. Benzer şekilde kolay ulaşılabilir örnekleme yönteminin yaygın olarak tercih edilmesinin sebebi yöntemin araştırmaya hız ve pratiklik kazandırmasının yanı sıra maliyet ve ulaşılabilirlik açısından kolay olarak algılanmasıdır (Yıldırım ve Şimşek, 2011, s.113). Ancak eğitime teknoloji entegrasyonu bağlamında bakıldığında öğretmenlerin TPAB düzeylerine yönelik çalışmaların göreceli olarak azlığı bir eksiklik olarak görülmektedir.

Türkiye ve Türkiye dışındaki ülkelerde yapılmış TPAB ile ilgili çalışmalarda kullanılan araştırma yöntemleri açısından baktığımızda; Türkiye'de yapılan çalışmalarda nicel yöntemlerin (f=27), karma (f=11) ve nitel (f=10) yöntemlere göre daha fazla tercih edilmesine rağmen, Wu (2013), TPAB ile ilgili yapılmış deneysel çalışmalarda nitel (f=10) ve nicel (f=11) çalışma sayısının hemen hemen birbirine yakın olduğunu tespit etmiştir. TPAB ile ilgili Türkiye'de yapılmış çalışmalarda veri toplama aracı olarak anketin (f=41), diğer veri toplama araçlarına göre farklı bölgelerde daha düşük maliyetle daha büyük gruplara, daha hızlı bir şekilde uygulanabildiği için araştırmalarda yaygın olarak tercih edildiği (Büyüköztürk, Kılıç Çakmak, Akgün, Karadeniz ve Demirel, 2013), TPAB ile ilgili Türkiye'de yapılmış çalışmalarda da benzer nedenlerle veri toplama aracı olarak anketin yaygın olarak kullanıldığı düşünülmektedir.

Türkiye'de TPAB ile ilgili yapılmış çalışmalarda en çok kullanılan veri analiz yönteminin; nicel veri analiz yöntemlerinden betimsel analiz olduğu görülmektedir. Türkiye'de yapılmış farklı alanlardaki çalışmaları inceleyen çalışmalarda; nicel veri analiz yöntemlerinden betimsel analiz yönteminin daha çok kullanıldığını tespit eden araştırmalar olduğu gibi (Göktaş vd., 2012; Varışoğlu, Şahin ve Göktaş, 2013), nicel veri analiz yöntemlerinden kestirimsel analiz yönteminin daha fazla kullanıldığını tespit eden bir çalışma (Göksu vd., 2014) da bulunmaktadır. TPAB ile ilgili Türkiye'de yapılmış çalışmalarda veri analiz yöntemi olarak nicel analiz yöntemlerinden betimsel analiz yönteminin daha çok tercih edilmesinin, TPAB çalışmalarının daha çok TPAB düzeylerini tanımlamaya yönelik olmasından kaynaklandığı söylenebilir. Bununla birlikte alanda TPAB ilgili nicel ve nitel desenlerin birlikte kullanıldığı karma desenli çalışmalara ihtiyaç duyulduğu görülmektedir. Nicel ve nitel yöntemlerin birlikte kullanıldığı çalışmalar TPAB düzeylerine yönelik daha sağlıklı sonuçlar verdiği gibi TPAB ile ilgili yapılacak diğer çalışmalara da büyük katkı sağlayacaktır.

SONUÇ VE ÖNERİLER

Bu çalışmada Türkiye'de TPAB ile ilgili yapılan çalışmalar; yayınlandıkları yıl, araştırdığı konu, uygulandıkları alan, örneklem düzeyi, kullanılan yöntem, veri toplama aracı ve veri analizi yöntemine göre incelenmiş olup araştırmanın sonuçları şu şekildedir:

- TPAB ile ilgili Türkiye'de yapılan çalışmalar yıllara göre artış göstermektedir.
- TPAB ile ilgili Türkiye'de yapılmış çalışmalarda en çok araştırılan konunun, çeşitli demografik değişkenler ve başarı düzeyleriyle TPAB arasındaki ilişki olduğu görülmektedir.
- Matematik ve fen alanlarında daha çok araştırma yapıldığı tespit edilmiştir.
- Örneklem seçiminde kolay ulaşılabilir örneklem yönteminin daha çok tercih edildiği görülmektedir.
- Öğretmenlerden çok öğretmen adaylarının TPAB düzeylerini inceleyen çalışmaların yapıldığı tespit edilmiştir.

Yapılan çalışmalarda araştırma yöntemlerinden nicel araştırma yöntemleri, veri toplama aracı olarak anket ve veri analizi yöntemi olarak da nicel yöntemlerden betimsel veri analizi yöntemi daha çok tercih edilmiştir.

Bu bağlamda TPAB ile ilgili yapılan çalışmaların gün geçtikçe arttığı ve yapılan çalışmaların günümüzde farklılaştığı ve daha farklı konu alanlarında, farklı yöntemlerle yapılacak çalışmalara ihtiyaç duyulduğu söylenebilir. Bu bulguları göz önünde bulundurarak TPAB ile ilgili yapılacak çalışmalar için önerilerimiz şunlardır:

- TPAB çerçevesi ve alt boyutlarının çeşitli demografik değişkenler (yaş, cinsiyet, akademik başarı, deneyim, branş vb.) ile ilişkisini inceleyen birçok çalışma yapıldığı için öğretmenlerin teknolojiyi etkin kullanımı, derslerine entegrasyonu, TPAB becerilerinin geliştirilmesi vb. bir çok konuda farklı çalışmalara ihtiyaç duyulmaktadır.
- Matematik ve fen alanlarında olduğu gibi başta eğitime teknoloji entegrasyonunda kilit rol üstlenen bilişim teknolojileri alanı olmak üzere diğer alanlarda da TPAB ile ilgili çalışmaların arttırılması gerekmektedir.

- Eğitime teknoloji entegrasyonu bağlamında düşünüldüğünde öğretmen adaylarıyla ilgili yapılan çalışmalar kadar görevi başında olan öğretmenlerin TPAB düzeyleri ve bunların geliştirilmesiyle ilgili çalışmaların arttırılması son derece önemlidir.
- TPAB ile ilgili yapılacak çalışmalarda nicel çalışmaların yanı sıra nitel ve karma çalışmalara ağırlık verilmesi alanyazının gelişmesine büyük bir katkı sağlayacaktır.

Sonuç olarak bu öneriler ışığında TPAB ile ilgili yapılmış çalışmaların belirtilen bağlamlarda incelenmesinin literatüre katkı sağlayacağı, yapılmış çalışmalardaki farklılıkları ve benzerlikleri ortaya çıkaracağı ve yapılacak çalışmalara ışık tutacağı düşünülmektedir.

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EKLER

Ek 1. Çalışmaların Yıllara ve Yayınlandığı Yere Göre Dağılımı

Dergi Adı	2009	2010	2011	2012	2013	Toplam
Procedia Social and Behavioral Sciences	1	1	-	2	-	4
Kastamonu Üniversitesi Kastamonu Eğitim Dergisi	-	-	1	-	1	2
İlköğretim Online Dergisi	-	-	1	-	-	1
Ahi Evran Üniversitesi Kırşehir Eğitim Fakültesi Dergisi	-	-	1	-	1	2
The Turkish Online Journal of Educational Technology	-	-	1	-	-	1
Gaziantep Üniversitesi Sosyal Bilimler Dergisi	-	-	1	-	-	1
Hacettepe Üniversitesi Egitim Fakültesi Dergisi	-	-	1	-	1	2
Necatibey Eğitim Fakültesi Elektronik Fen ve Matematik Eğitimi Dergisi	-	-	-	1	-	1
The Journal of Mathematics Teacher Education	-	-	-	1	-	1
Mustafa Kemal Üniversitesi Sosyal Bilimler Enstitüsü Dergisi	-	-	-	1	-	1
Journal of Computer Assisted Learning	-	-	-	1	-	1
Australasian Journal of Educational Technology	-	-	-	1	-	1
Computers & Education	-	-	-	1	-	1
Pamukkale Üniversitesi Eğitim Fakültesi Dergisi	-	-	-	-	1	1
Eurasian Journal of Educational Research	-	-	-	-	1	1
Technology, Pedagogy and Education	-	-	-	-	1	1
International Journal of Human Sciences	-	-	-	-	1	1
Educational Sciences: Theory & Practice	-	-	-	-	2	2
Batı Anadolu Eğitim Bilimleri Dergisi	-	-	-	-	1	1
Eğitim ve Bilim	-	-	-	-	1	1
Elektronik Sosyal Bilimler Dergisi	-	-	-	-	1	1
Uşak Üniversitesi Sosyal Bilimler Dergisi	-	-	-	-	1	1
Journal of Digital Learning in Teacher Education	-	-	-	-	1	1
Ege Eğitim Dergisi	-	-	-	-	1	1
Education As Change	-	-	-	-	1	1
Yök Tez Veritabanı - Yüksek Lisans	2	1	5	3	3	14
Yök Tez Veritabanı - Doktora	-	-	1	2	-	3
Toplam	3	2	12	13	19	49

Ek 2. Araştırma kapsamında incelenen çalışmalara ait referans listesi

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